User's Manual

ICP Controllers of the GDT RN Series

64-Bit PCI-Fibre Channel RAID Controllers

1st Edition

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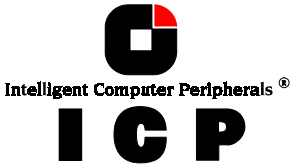
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***The following chapters are part of a* PDF-*document which is located in a corresponding directory on the* ICP System CDROM:**

Using IBM OS/2 v2.x
Using Interactive UNIX
GDTSETUP in Detail

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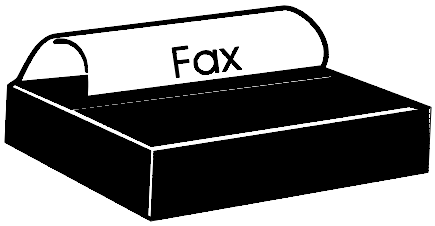

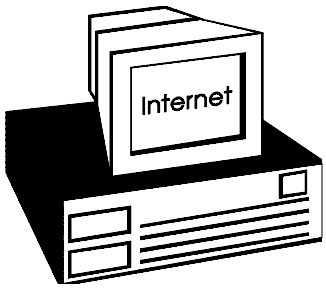

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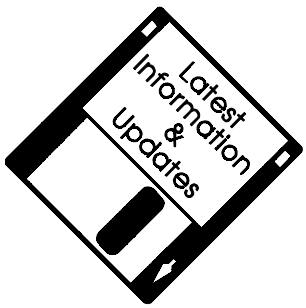

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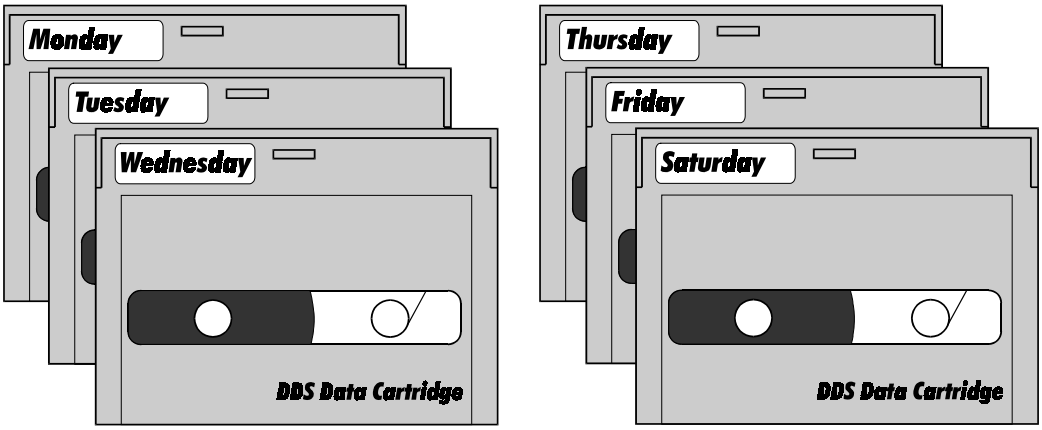
Important Note

Using modern RAID Systems significantly increases data security and availability. U*nder no circumstances* does it relieve you from a careful and daily backup on tape or a similar backup media. This is the only method to protect your valuable data against total loss (e.g., through fire or theft), accidental deletion, or any other destroying impacts.



Many Thanks to all my Friends

Monika & Wolfgang (the grandmasters)
AnnDee, Lois, Frank, Ken and Andreas (the Phoenix Crew)
Achim, Dieter, Günter, Hooshiar, Norbert, Otto, Ralph, Sam, Steffen, Winfried
(they are the real wizards)
Alfred (AB, "We need .... . I say we have it")
Andreas (AK, or "Kopf nur mit ö")
Michael (Mipf, "where is my CPU ?")
Jürgen (Jogo, "Hi, is Jurgen there ?")
Ruth (RA, "she had to proof-read that thing, ...)
Johannes (JS, "I want my ice with a red cap .., or Dr. Oops-Click-Click...")
Jürgen (JB, "diesbezüglich & hinsichtlich or probably")
Klaus (KLM, "..not an Airline..")
Markus (Malu, "Luuuuu...."), Uwe

All the fantastic "rest" of this incredible company.

It is not only a pleasure to work here, it is a passion.

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NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in residential installations. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorientate or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Plug the equipment into an outlet on a circuit different from that to which the receiver is powered.
- If necessary, consult the dealer or an experienced radio/T.V. technician for additional suggestions.

The use of a non-shielded interface cable with the referenced device is prohibited.
Changes or modifications not expressly approved by ICP vortex Computersysteme GmbH could void the authority to operate the equipment.

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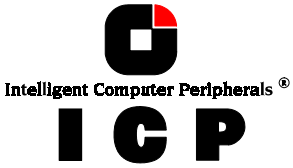
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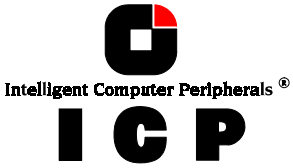
Chapter A

General

Information



A. Introduction

64 Bit Hardware RAID Disk Array Controllers with 1 or 2 Fibre Channel Interfaces for 32 Bit and 64 Bit PCI Bus Computer Systems

In order to take full advantage of modern operating systems, high performance computer systems are needed. When assessing the performance of a computer system, the aspects speed and security of the mass-storage subsystem are gaining increasing importance. As a result of the constantly growing acceptance of the RAID technology (Redundant Array of Independent Disks) in these computer systems, and the identification of the RAID controller as the essential part of a disk subsystem, a strong demand for suitable RAID controllers has emerged during the past few years.

Since 1990, ICP vortex has been intensively engaged in the research and development of RAID products for the highest performance and security requirements. Due to our products' outstanding performance, our expertise and continuity in development, ICP Controllers are accepted and known as top leading-edge products all over the world. ICP Controller products within the GDT RN Series are suitable for the most different platforms and applications. All ICP Controllers of the GDT RN Series are *pure-bred* ***hardware solutions***.
All functionality required for the very complex tasks is hardware-implemented on the controller. Thus, RAID is fully independent of the computer system (the host) and the operating system.

Thanks to the wide operating system support and easy-to-use installation and maintenance utilities, setting up and using high performance and fault-tolerant mass-storage subsystems for almost every purpose is child's play.

We would like to thank you for purchasing an ICP Controller of the GDT RN Series.

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A.1 Product Identification

In order to meet the various customer and system requirements, ICP vortex offers four 64 Bit Fibre Channel RAID Disk Array Controllers for PC-based 32 Bit and 64 Bit PCI computer systems. The main differences between the controllers lie in the number of Fibre Channel Interfaces and the Clustering Support .

Order Number	*ICP Controller Name*	*Number of Fibre Channel Interfaces*	*One Wide/Ultra SCSI Channel*	*Clustering Support*	*Supported RAID Levels*
7519	GDT7519RN	1	Yes	Optional	0/1/4/5/10
7529	GDT7529RN	2	Yes	Optional	0/1/4/5/10
7619	GDT7619RN	1	Yes	Yes	0/1/4/5/10
7629	GDT7629RN	2	Yes	Yes	0/1/4/5/10

A.1.1 Key Features of the ICP Controllers of the GDT RN Series

- 64 Bit Hardware RAID Controllers with RAID 0, RAID 1, RAID 4, RAID 5 and RAID 10 Array Drives at controller level, completely independent of the computer system and the operating system. Several Array Drives can be operated simultaneously.
- Operation in 64 Bit and 32 Bit PCI slots. Full Bus Mastering. Maximum data transfer rates: 132MB/sec in a 32 Bit PCI slot and 264MB/sec in a 64 Bit PCI slot.
- "Private" (i.e, for one Array Drive) or "Pool" (i.e., for several Array Drives) Hot Fix Drives.
- Online Capacity Expansion. Add one or several new disk drives to an existing Array Drive to expand its capacity. During the Expansion all data are redundant.
- Online RAID Level Migration. Online change of an Array Drive's RAID Level, e.g., from RAID 0 to RAID 5.
- Online Capacity Expansion and RAID Level migration can be performed simultaneously.
- ROM-resident configuration utility GDTSETUP. Express Setup option to easily setup Array Drives. Press "CTRL-G" to load GDTSETUP, long before the operating system is booted.
- ICP RAID Navigator. GUI-Tool for Windows 95/98/NT.
  GDTMON. Character oriented program for Windows 95/98/NT, NetWare, Linux, OS/2, SCO UNIX, UnixWare, Interactive UNIX.
  Both tools allow the setup and monitoring of ICP Controllers with their array drives. Remote operation. Intelligent messaging.
- On-Board i960RN © Intelligent 64 Bit I/O Processor (100MHz). Completely offloads the host CPU.
- One, or two 64 Bit Fibre Channel Interfaces with HP Tachyon TL and onboard copper transceivers with 100MB/s channel. Support of Arbitrated Loop Topology.
- Up to 25 meters with copper cable. Standard DB9 connectors.
- Support of MIAs (Media Interface Adapter) for large cable length.
- 1 full-featured additional Wide/Ultra SCSI channel for legacy SCSI devices (hard disks, CDROMs,. etc.) with third generation 32 SCSI RISC processor and an active, software-switchable termination. Dual connector system (50 pin and 68 pin connector). Synchronous data transfer rate up to 40MB/sec.
- ECC-SDRAM-Module as Cache RAM: 16MB; 32MB, 64MB. Automatic Cache RAM detection. Optional Battery Backup Module.
- Intelligent multi-level cache-algorithm with adaptive delayed write and read ahead functions. This ensures an optimized cache for various load profiles and system requirements.
- On-Board PCI 2.x compatible BIOS (Plug & Play).
- BIOS, Firmware and GDTSETUP in Flash-RAM. Easy update.

- Drivers for MS-DOS, Novell NetWare, SCO UNIX V/386, Interactive UNIX, UnixWare, Linux, Windows NT, Windows 95/98 and OS/2. ASPI-Managers for DOS, Windows and Novell NetWare. I_2O ready controller design.

- Controllers equipped with Cluster RAIDYNE® Firmware (GDT7619RN and GDT7629RN) include support for Microsoft® Cluster Server® (MSCS).

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A.4 General Information

The ICP Controller should be installed by an authorized ICP vortex distributor. Precondition for the safe installation is an anti-static work place (earthed mat on the table with wrist bands connected to an earth). ICP vortex does not take any responsibility for damage arising out of improper installation. This manual contains all the information available at the time it was written. Errors and/or incomplete information are possible. We are grateful for any ideas or suggestions for improvement. Additional information may be found in the information file **"README.TXT"** on the enclosed ICP CDROM. Besides up-to-date information, this file also contains a list of all programs on the CDROM.

The contents of the file README.TXT must be read before the ICP Controller is used for the first time. Output is possible on printer or screen.

This **User's Manual** explains the installation and the operation of the ICP Controller. For information on the use of the computer system and its operating system, please refer to the corresponding system manuals.

A.4.1 Unpacking the ICP Controller

Open the show box and take out the ICP Controller (leaving it in its anti-static bag), the CDROM and this manual.
WARNING: Never take the GDT PCB (Printed Circuit Board) out of the anti-static bag unless this is done at an anti-static work place, and the person handling the ICP Controller is secured with wrist bands against electrostatic charge. If these instructions are not observed, the CMOS components on the ICP Controller may be damaged or destroyed.
Store the show box in a safe and dry place.

A.4.2 Delivery Contents

The following items are delivered with the ICP Controller:

1. ICP Controller in a sealed anti-static bag.
2. Sealed CDROM with driver and installation software.
3. This User's Manual.

A.4.3 Contents of the ICP CDROM

A list of the files and programs delivered with the ICP Controller can be found in the file **README.TXT** on the enclosed CDROM. The contents of this file can be viewed on screen or output on your printer. Besides these files and programs there are also disk images of all ICP driver floppy disks, which can be used with a special image-writing program to create a full set of disks. This can be helpful if you require for example a BTLD floppy disk for the installation of the ICP Controller under SCO UNIX.

A.4.4 Before You Start

In order to avoid damage caused by improper or faulty usage or handling, **we strongly recommend** reading this manual carefully before installation or first operation.

A.5 Product Description

A.5.1 Intel i960RN I/O Processor

The i960RN I/O processor is a member of a new RISC CPU generation which was specifically designed for I/O applications. This pure 64 Bit CPU on an ICP Controller can reach a performance of **+100 MIPS** and supervises all tasks of the Fibre Channel / SCSI devices, the RAID controlling and the communication with the PCI computer. In doing so, it significantly offloads the PCI computer, leaving it free to perform its original tasks.

A.5.2 64 Bit Architecture

To meet the demands on a high performance controller, the bus architecture of the ICP Controller has a **64 Bit** layout.

- 64 Bit control processor (i960RN I/O Processor)
- 64 Bit Fibre Channel processors (Tachyon TL)
- 64 Bit bus-interface (PCI)

A.5.3 Cache RAM - Expandable to 64MB

The cache RAM of an ICP Controller consists of one ICP ECC-SDRAM-Module (ESM). The cache size is flexible as different memory sizes can be obtained by using different modules. Thus, the memory can be expanded to 16MB, 32MB or 64MB. An intelligent multi-level cache algorithm ensures that a high hit rate (cache hit) is achieved. Both, look-ahead and special delayed-write cache functions are implemented. With the ICP configuration program GDTSETUP and the monitoring utilities GDTMON and ICP RAID Navigator, the user can adjust various cache parameters.

A.5.4 Compatibility - PCI

The ICP Controllers have been developed in accordance with the 2.1 PCI-Bus specifications. They perform full bus-master DMA and can be operated in both, 32 Bit and 64 Bit PCI bus mastering slots. The transfer rates are 132MB/sec in a 32 Bit PCI slot and 264MB/sec in a 64 Bit slot.

A.5.5 Up to 2 Fibre Channel Interfaces plus 1 Ultra/Wide SCSI Channel

The ICP Controllers are available with one or two Fibre Channel interfaces and have always one Wide/Ultra SCSI channel for legacy SCSI devices. Per Loop up to **126 devices** can be connected. The maximum data transfer rate is **100MB/sec on the Fibre Channel** and **40MB/sec on the Wide/Ultra SCSI channel.**

The Wide/Ultra SCSI channel is equipped with a SCSI-2-compliant (*alternative* 2), active, and software-switchable SCSI bus termination, which allows for a separate termination of the lower and higher byte of the SCSI bus.

A.5.6 ICP Controller Firmware RAIDYNE®, PCI-BIOS and GDTSETUP

The firmware, the BIOS of the ICP Controller and the configuration program GDTSETUP are stored in a Flash-RAM on the ICP Controller PCB. The firmware is designed for parallel processing and it controls all resources of the ICP Controller. This means that the entire administration of the devices and RAID is exclusively carried out by the ICP Controller. Thus, the host is significantly offloaded. In addition, this hardware-implemented solution guarantees the highest achievable security. The controller-BIOS provides a complete PCI

compatible INT13 interface (with 8GB DOS-partition extension and 7 BIOS drives) and expands the respective functions of the system BIOS. It also ensures that operating systems using the INT13 (i.e. MS-DOS, Windows NT) can be booted directly from a device / RAID Array Drive connected to the ICP Controller. The RAIDYNE® firmware allows for the simultaneous operation of disk arrays with the RAID Levels 0, 1, 4, 5, 10. RAIDYNE is also capable of performing an online capacity expansion of an existing array by adding one ore more new hard disks. During expansion the array is fully operational. Another feature of RAIDYNE® is the online RAID Level Migration of an existing array, e.g., from RAID 0 to RAID 5.
GDT7619RN and GDT7629RN are equipped with the "Cluster RAIDYNE®" firmware, which not only includes all necessary functions for supporting the Microsoft® Cluster Server® (MSCS), but is also ready for future Controller and Server-Cluster concepts. There is an optional "Cluster Module" to upgrade GDT75x9RN to GDT76x9RN.

A.5.7 Configuration Program GDTSETUP

GDTSETUP is either loadable from the Flash-RAM of the ICP Controller (press <CTRL><G> after the ICP Controller shows its BIOS), or from the command prompt under MS-DOS. GDTSETUP has a character-oriented graphical user interface. It provides besides others the following functions:

- Configuration of SCSI and Fibre Channel devices connected to the ICP Controller and administrated by RAIDYNE®. These are normally all types of hard disks. Other devices like CDROM, DAT, DLT, WORM, MOD, etc. are either operated by means of the ASPI interface, or are directly supported by the operating system (RAW device).
- EXPRESS and ADVANCED configuration of single disks, or RAID 0, 1, 4, 5 and 10 array drives.
- Configuration of the ICP Controller's cache.

A.5.8 Diagnosis Programs "ICP RAID Navigator" and "GDTMON"

These two diagnosis programs are very flexible software tools that offer many different diagnosis and maintenance functions during full-operation conditions. GDTMON has a character-oriented user surface and is ideally suitable for NetWare and all types of UNIXes including Linux. ICP RAID Navigator has a Windows NT compliant graphical user interface (GUI) and can be operated under Windows 95/98/NT. Booth tools can be used on the file-server, or remotely from an authorized workstation. The main functions are:

- Monitoring the disk subsystem performance (KB/sec and I/Os per sec.)
- Monitoring the utilization of the on-board cache
- Online configuration of the cache memory
- Online changes of device parameters
- Online check of the parity information of RAID 4 and RAID 5 Array Drives
- Online capacity expansion and RAID level migration of existing Array Drives
- Hot Plug and Hot Fix

A.5.9 Operating System Driver Software

Drivers for the following operating systems are available:

Operating System	Driver included with the Controller Package
MS-DOS 3.3 to 6.x	Yes
Novell NetWare 3.11, 3.12, 4.x, 5.x	Yes
SCO UNIX System V/386 3.2v5.x	Yes
Interactive UNIX V/386 3.2v3, 3.2v4	Yes
SCO UnixWare 2.x and 7	Yes
IBM OS/2 2.x, Warp 3, Warp 4	Yes
Windows NT	Yes
Windows 95/98	Yes
Linux	Yes

The following table shows how various devices are integrated by different operating systems. Please refer to the corresponding chapters of this User's manual and the operating system documentation for detailed installation information.

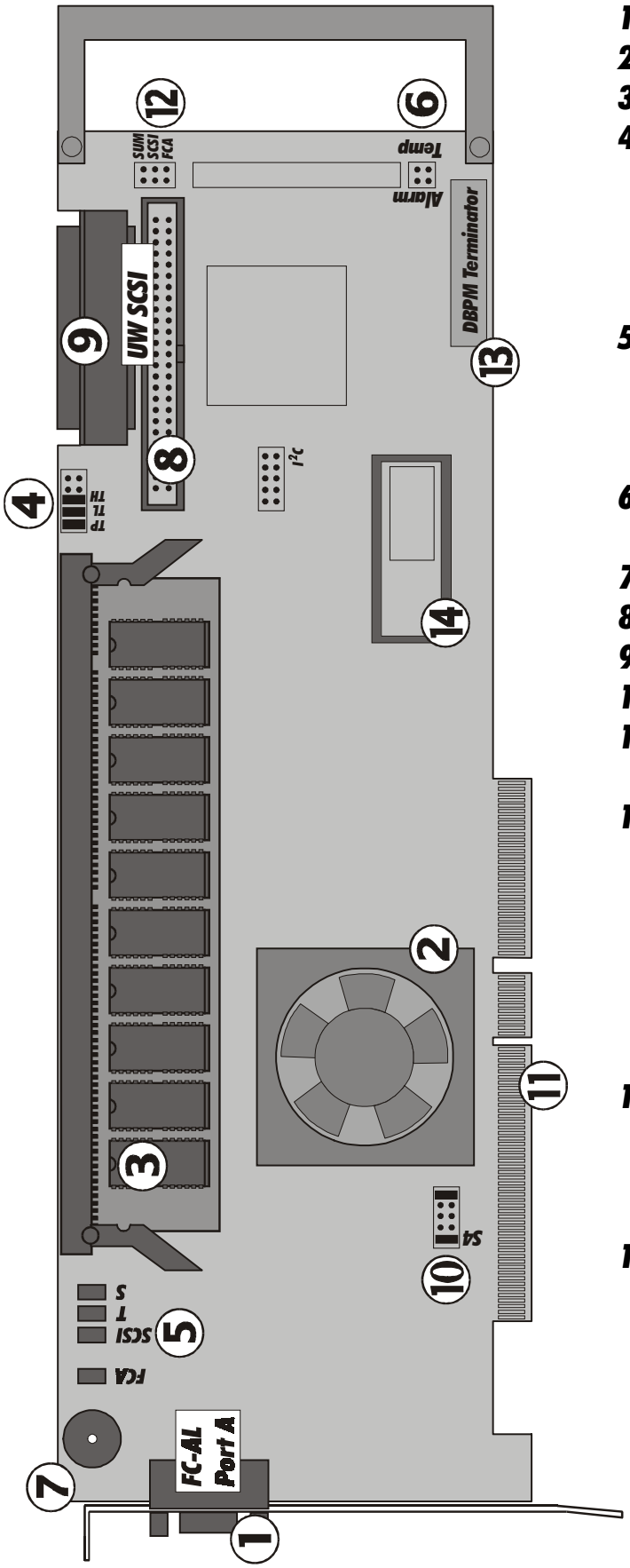
	Hard Disk	Remov. HDD	CDROM	Streamer	WORM	MOD
MS-DOS	GDT	ASPI or GDT	ASPI	ASPI	ASPI	ASPI/GDT
NetWare	GDT	GDT	ASPI	ASPI	ASPI	ASPI/GDT
UNIX/LINUX	GDT	GDT	UNIX	UNIX	UNIX	UNIX/GDT
Win. NT	GDT	Win.NT or GDT	Win.NT	Win.NT	Win.NT	Win.NT
OS/2	GDT	OS/2 or GDT	ASPI	ASPI	ASPI	ASPI or GDT

GDT: Configurable with GDTSETUP (some MODs are recognized as a hard disk (see your MOD manual). In this case, they too can be configured with GDTSETUP). **ASPI:** Integration by means of an ASPI interface. **UNIX/LINUX, OS/2, Win.NT:** Supported by the operating system.

A.5.10 ICP Controller GDT RN Series Board Layout

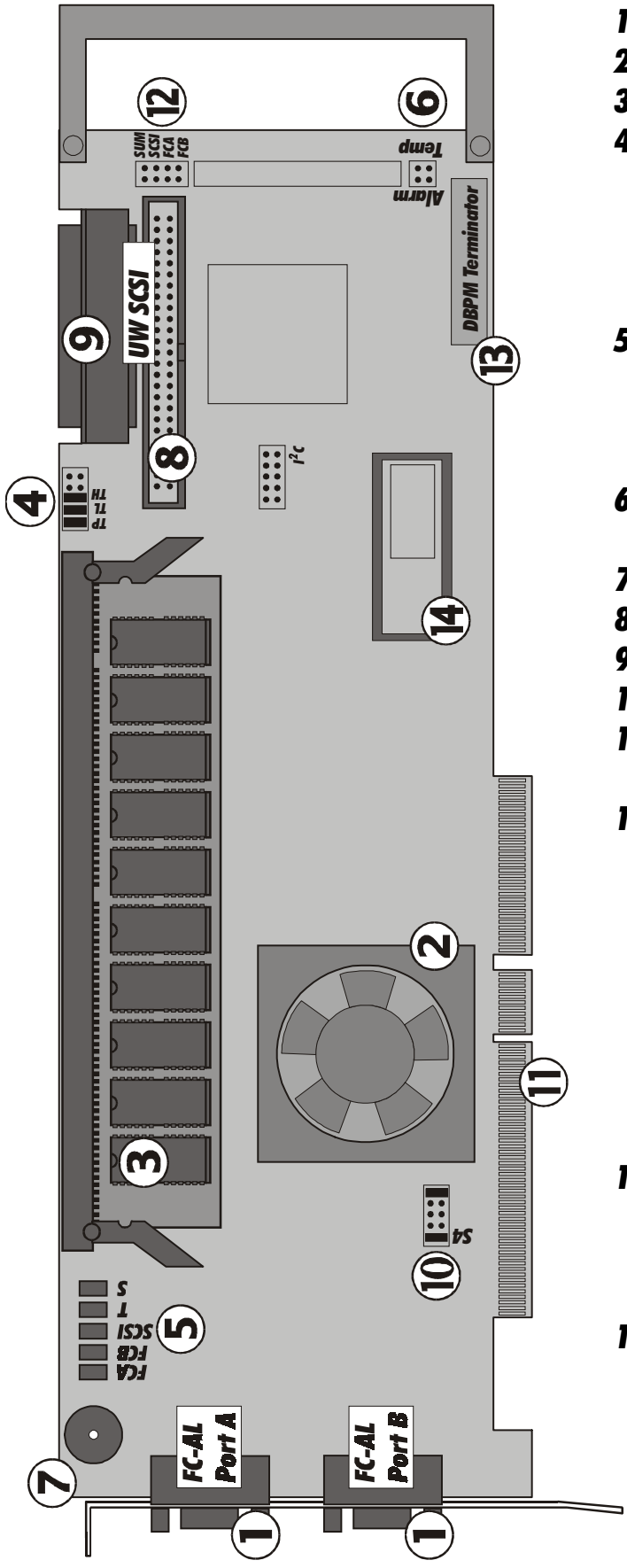
The ICP Controller PCB (Printed Circuit Board) has several jumpers. In the following illustrations, all jumpers are shown in their factory setting. No other jumpers except the TP, TL, TH and S4 jumpers are user-serviceable and must remain in their displayed position. An installed TP jumper means that the ICP Controller supplies the termination power on the SCSI cable of the Wide/Ultra SCSI channel. TL stand for Termination Low-Byte and TH for Termination High-Byte. These two jumpers may be used to bypass the termination settings within GDTSETUP.

GDT7519RN and GDT7619RN Overall View

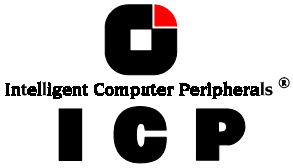


1. DB9 connector for FC-AL port A.
2. CPU cooler for i960RN.
3. SDRAM module (not included).
4. TP. Terminator Power Jumper for Wide/Ultra SCSI channel.
   TL/TH. Jumpers for manual termination of Wide/Ultra SCSI channel (L=Low-Byte; H=High-Byte)
5. LEDs. S(green)=Status.
   T(green)=DMA transfer.
   SCSI,FCA(yellow)=Activity on FC-AL and Wide/Ultra SCSI.
6. Connectors for secondary acoustical and temperature alarm.
7. Loudspeaker.
8. Connector for 50 pin SCSI cable.
9. Connector for 68 pin SCSI cable.
10. Jumper S4. Normally closed.
11. 64 Bit PCI Bus connector. Can also be plugged into a 32 Bit PCI slot.
12. Connector for external LEDs.
    Sum: All FC-AL and Wide/Ultra activities.
    FCA: Activity on FC-AL port A
    SCSI: Activity on Wide/Ultra SCSI channel. (Cathodes: near the 50 pin SCSI connector)
13. Terminator key if DRAM Battery Power Module not installed. (Key can be also installed 180 degrees clockwise rotated).
14. Socket for optional Cluster Module. (Not required for GDT7619RN. When installed on a GDT7519RN, controller becomes a GDT7619RN).

GDT7529RN and GDT7629RN Overall View



1. DB9 connectors for FC-AL ports A,B.
2. CPU cooler for i960RN.
3. SDRAM module (not included).
4. TP. Terminator Power Jumper for Wide/Ultra SCSI channel.
   TL/TH. Jumpers for manual termination of Wide/Ultra SCSI channel (L=Low-Byte; H=High-Byte)
5. LEDs. S(green)=Status.
   T(green)=DMA transfer.
   SCSI,FCA,FCB(yellow)=Activity on FC-AL and Wide/Ultra SCSI.
6. Connectors for secondary acoustical and temperature alarm.
7. Loudspeaker.
8. Connector for 50 pin SCSI cable.
9. Connector for 68 pin SCSI cable.
10. Jumper S4. Normally closed.
11. 64 Bit PCI Bus connector. Can also be plugged into a 32 Bit PCI slot.
12. Connector for external LEDs.
    Sum: All FC-AL and Wide/Ultra activities.
    FCA: Activity on FC-AL port A
    FCB: Activity on FC-AL port B
    SCSI: Activity on Wide/Ultra SCSI channel.
    (Cathodes: near the 50 pin SCSI connector)
13. Terminator key if DRAM Battery Power Module not installed. (Key can be also installed 180 degrees clockwise rotated).
14. Socket for optional Cluster Module. (Not required for GDT7629RN. When installed on a GDT7529RN, controller appears becomes


Intelligent Computer Peripherals ®
ICP

Chapter B

Hardware

Installation

Intelligent Computer Peripherals ®

ICP

B. Hardware Installation

B.1 Before Installation

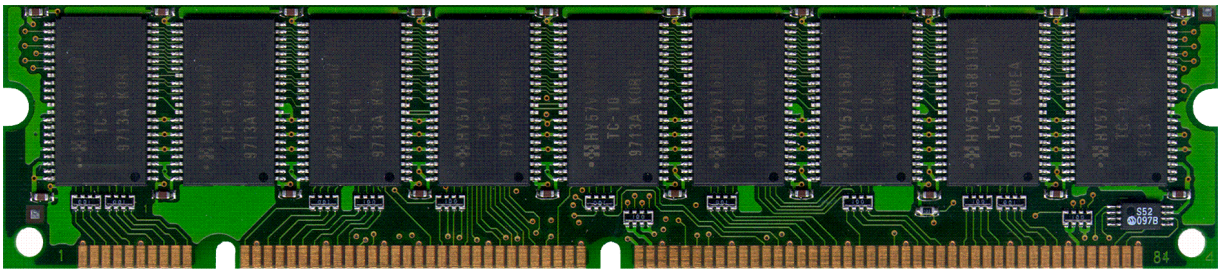
The ICP Controller is designed for minimum power consumption and maximum operational security. It therefore contains delicate electrical components (CMOS). In order to avoid damages caused by electrostatic charges, the following warning must be observed during installation:
Never take the ICP Controller out of the anti-static bag unless this is done at an anti-static work place and the person handling the ICP Controller is secured against electrostatic charge through wrist bands. If these instructions are not observed, the user risks damage or destruction of the CMOS components of the ICP Controller !

B.2 Tools

Before installing, please switch off the complete computer system and remove all cables including the power cable. Open the case of the host computer with an appropriate screwdriver (usually a medium sized Philips screwdriver).

B.3 Installing the ICP ECC-SDRAM-Module (ESM)

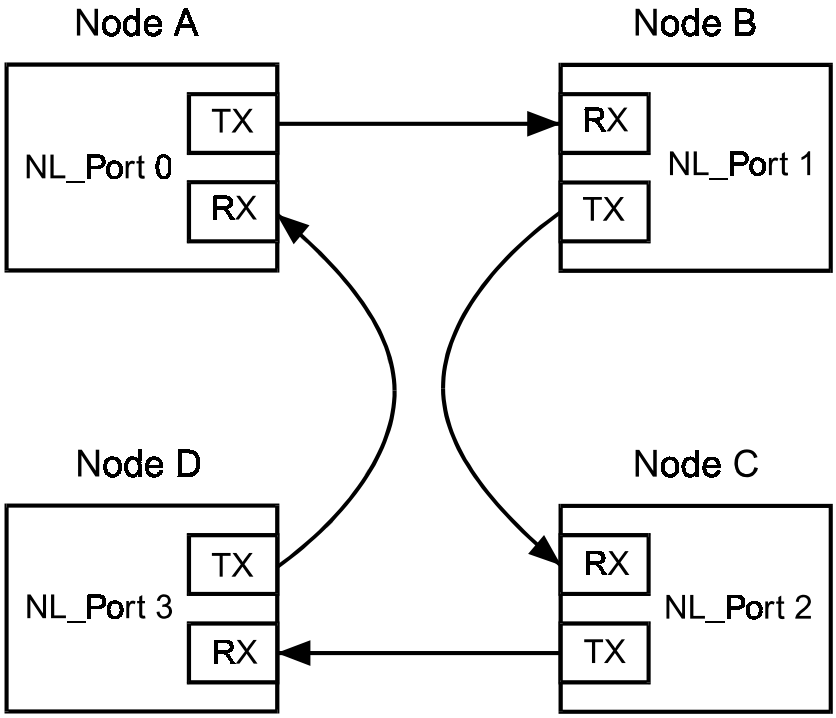
It is not possible to operate the ICP Controller without an ESM. The ICP Controller is delivered without ESM (0MB). Proper operation is only granted when using an original ICP ECC-SDRAM-Module. Please order an ICP ESM when you order your ICP Controller (16MB, 32MB or 64MB).



If the ICP Controller is not yet equipped with cache RAM, or if another ESM is to be installed, we recommend adding it before you install the ICP Controller in your computer system. As mentioned before, the ICP Controller can be run with three different cache RAM sizes. **The minimum cache RAM size is 16MB**. The maximum cache RAM size is 64MB.
The ICP Controller provides one socket for an ICP ECC-SDRAM-Module (SDRAM stands for Synchronous Dynamic RAM technology). The ESM is correctly plugged into the ESM socket of the ICP Controller if it is engaged correctly into the socket's retaining clamps and if all contacts of the ESM are equally contacting the corresponding pins of the socket. To release an installed ESM, carefully press the retaining clamps to the side.
Each time you switch on the computer system, the ICP Controller automatically recognizes how much cache RAM is available and configures itself accordingly.

B.4 Fibre Channel Arbitrated Loop Topology - Facts

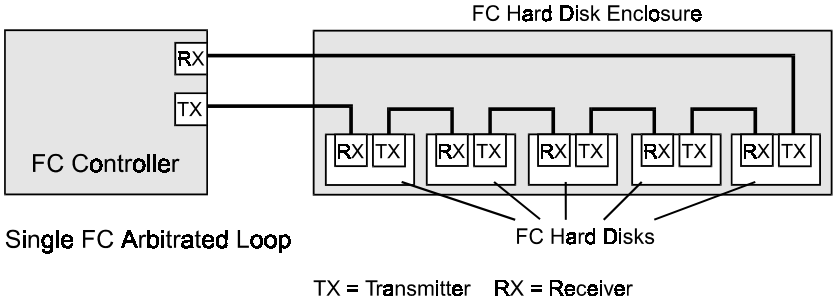
The GDT75x9RN and GDT76x9RN support the Arbitrated Loop Topology.
The Arbitrated Loop (AL) allows up to 127 ports to be connected in a circular daisy chain. Data is transferred from one device to its neighbor in the chain. The ports in an AL are designated as NL_Ports, and two ports can be active simultaneously. The other ports func-



tion as repeaters and simply pass the signal along. This means, of course, that the bandwidth of 100MB/sec is shared among all devices. Just as in a token ring, each device on the Arbitrated Loop sees every message, keeps those meant for it, and passes all others along. Fibre Channel Arbitrated Loop (FC-AL) is a subset of a Switched Fabric.

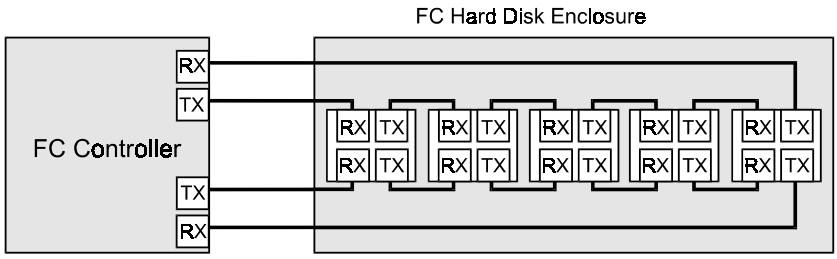
ICP controllers are available either as single port controllers (GDT7519RN, GDT7619RN), with one FC channel, or dual port controllers (GDT7529RN, GDT7629RN), with two independent channels.

Single channel systems cost less, but they have the disadvantage that if the cable itself, or



some other connecting component fails, the controller can no longer communicate with the FC devices.

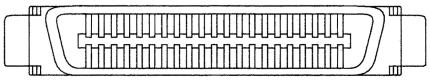
A dual port controller allows a system to be constructed with each device attached to both cables, so that if one cable fails, the other takes over all IO operations.



Dual FC Arbitrated Loop TX = Transmitter RX = Receiver

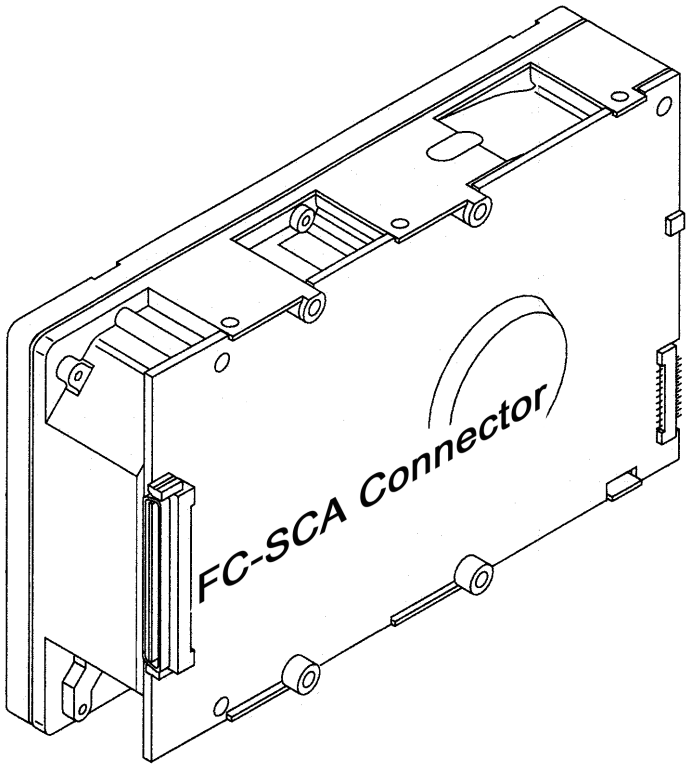
B.4.1 Fibre Channel Hard Drives

FC hard drives are built with a 40 pin SCA connector (Single Connector Attachment), which provides all necessary signal connections and electricity to the hard drives. This SCA connector enables hard drives to be easily built into an external enclosure with an SCA backplane. The drawback of the SCA connector, however, is that the hard drive can no longer be connected directly to the controller with a simple cable, but needs a specific FC-SCA to DB 9 adapter. This adapter converts the SCA connection on the hard drive into one or, in the



FC-SCA Connector (front view)

case of a dual port hard drive, into two DB 9 female connectors, so the appropriate DB 9 male connector can be attached. The adapter also has a connector for the electrical current to the hard disk. When using such adapters, a loop back connector must be used to complete the communication loop.
If the hard drives are used in a dual loop configuration, they must have two NL_Ports.



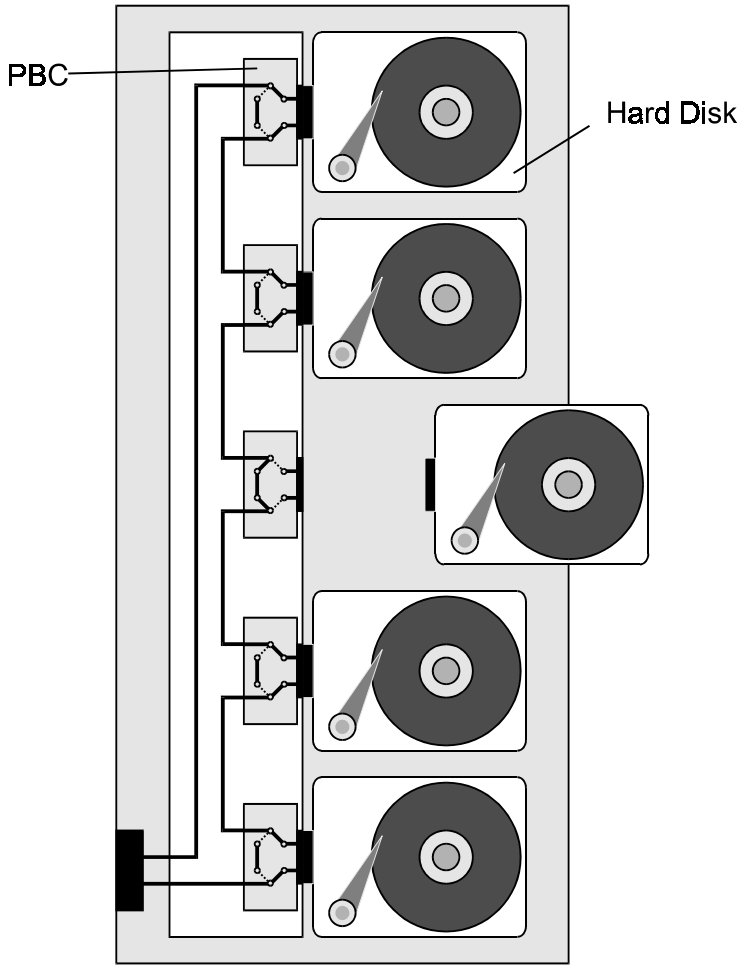
When choosing FC hard drives, those with the shortest seek times and highest RPMs usually provide best performance. The seek time refers to the amount of time the drive read/write head needs to access specific data sectors on the disk. The shorter the seek time, the less time spent waiting during random reads/writes. Higher RPMs translate into better sequential data transfer rates and better read/write times.

B.4.2 FC Hard Drive Enclosures

A FC hard drive enclosure functions not only to physically house the drives, but must also control electrical current and temperature. In choosing an enclosure, important features to consider are redundant and hot-swappable power supplies and fans. These components have a relatively high failure rate and, if they are not redundant, their failure can lead to hard drive failures. **The FC hard drive enclosure assigns to each hard drive a unique ID in the Loop.**

Enclosures for RAID systems must also support the interactive change-out of a hard disk during system operation (Hot-Plug). To achieve this, the enclosure must have Port Bypass Circuits (PBC), which are located on the backplane and redirect data paths while the failed hard drive is exchanged. This prevents disruption of the Arbitrated Loop. While using a system with PBCs, one must take care that the allowable cable lengths between devices specified for FC-AL are not exceeded. In addition, pay attention to whether the enclosure can support a dual loop configuration. In order to provide the highest level of fault tolerance, some FC enclosures have two completely independent, redundant loops. If the hard drives and controller also provide two FC ports, the system can be completely redundant, with redundant cabling. If one loop fails completely, the second can still carry all communications between controller and hard drives.

Another consideration is whether the enclosure supports Media Interface Adapters (MIA).



These adapters transform the electrical signals from hard drives into optical signals. In order for these adapters to function, however, the DB 9 connectors must provide the necessary electrical support. MIAs allow a controller with copper cabling to be used with a fiber optic system.

A modern enclosure should also provide a management interface, through which a RAID controller can communicate information regarding the status of the system. For example, the enclosure would communicate information about fan or power supply failure to the controller, which would then notify the system administrator. Similarly, the controller communicates with the enclosure, indicating which hard disk has failed, so that the system administrator can see on the enclosure display (Fault LEDs or LCDs) which disk needs to be swapped.

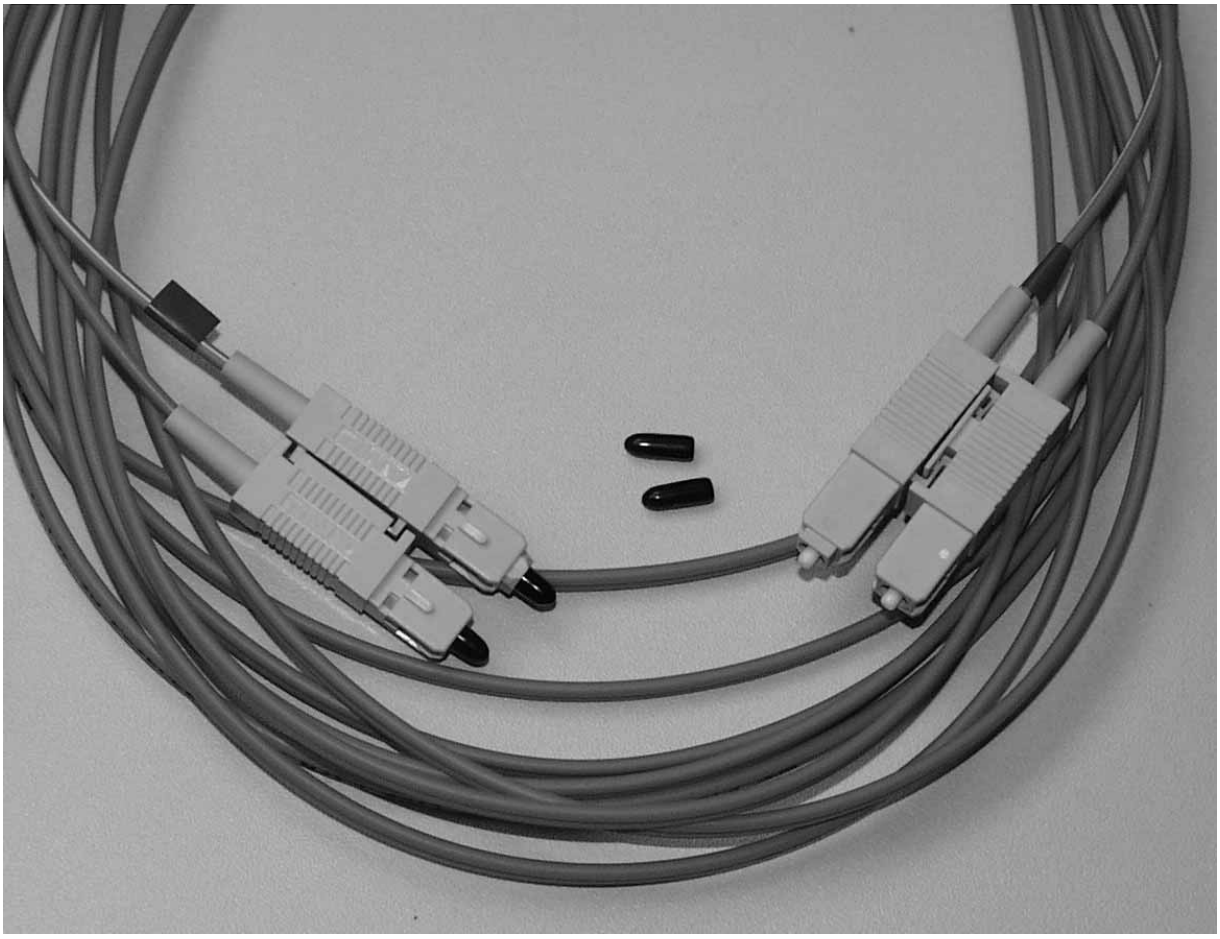
B.4.3 FC Connectors and Cables

A net data transfer rate of 100 MB/sec corresponds to a signal frequency on the FC cable of 1 GHz. This extremely high frequency necessitates the highest quality connectors and cables, which means only those from reputable manufacturers should be used.
Because the distances between individual FC devices (RAID controllers and hard drives) in

Example for a copper cable.

mass storage systems are not great, the less expensive copper cabling is most often used. Three different kinds of copper cabling with DB 9 connectors (similar to serial PC interface) are defined for FC: Video Coaxial, Miniature Coaxial and Shielded Twisted Pair. This cabling enables the 100 MB/sec transfer rate for distances up to 25 meters. If the FC devices or device groups (such as a complete FC enclosure) have to be further than 25 meters apart, the

signal transmission can be carried via optical fiber. The 50 µm multi mode optical fibers with shortwave lasers can handle cable lengths up to 500 meters, and the 62.5 µm multi Mode optical fibers up to 175 meters. SC duplex connectors should be used in these situations. 9 µm single mode optical fiber with longwave lasers can travel up to 10 km. (The distances discussed here refer to the distance between devices, not the length of the entire cable, as is the case with SCSI.)
Because the laser power necessary for the extremely long distances poses a threat to the human eye, a protective system called Open Fiber Control (OFC) has been defined. The receiver normally sends continual acknowledgments of receipt of the laser signals. If the transmitter does not receive this acknowledgement, the laser signals are immediately stopped.
There is also a non-OFC system, used when the power of the laser is not dangerous to the eye, so no receipt acknowledgements are sent. OFC and non-OFC systems are not compatible.



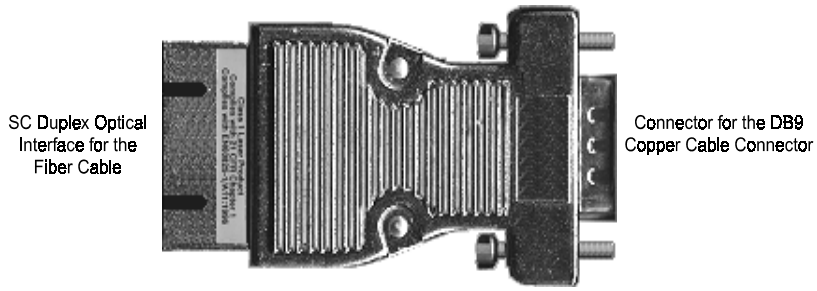
Example for a fibre optics cable.

B.4.4 Media Interface Adapter (MIA) - ICP Order No.: 8950

MIA adapters transform the electrical signals used by copper cables into optical signals transmitted by optical fibers. One end of the adapter has an FC DB 9 male connector and the other end has an SC duplex female connector for the optical fiber.

MIA

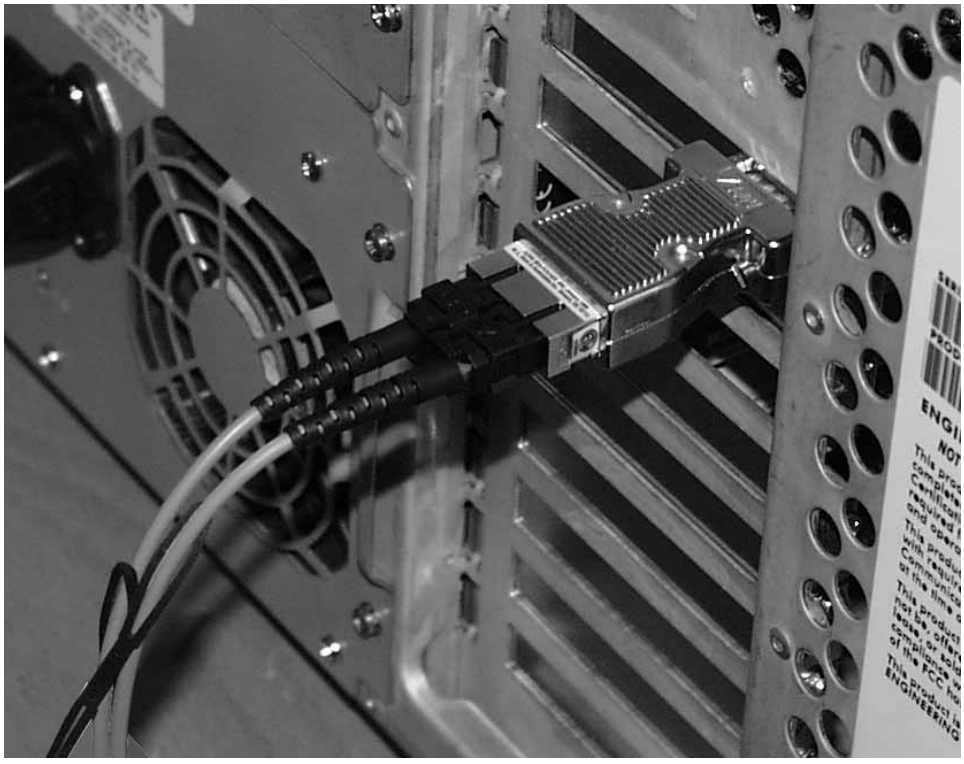
Media Interface Adapter

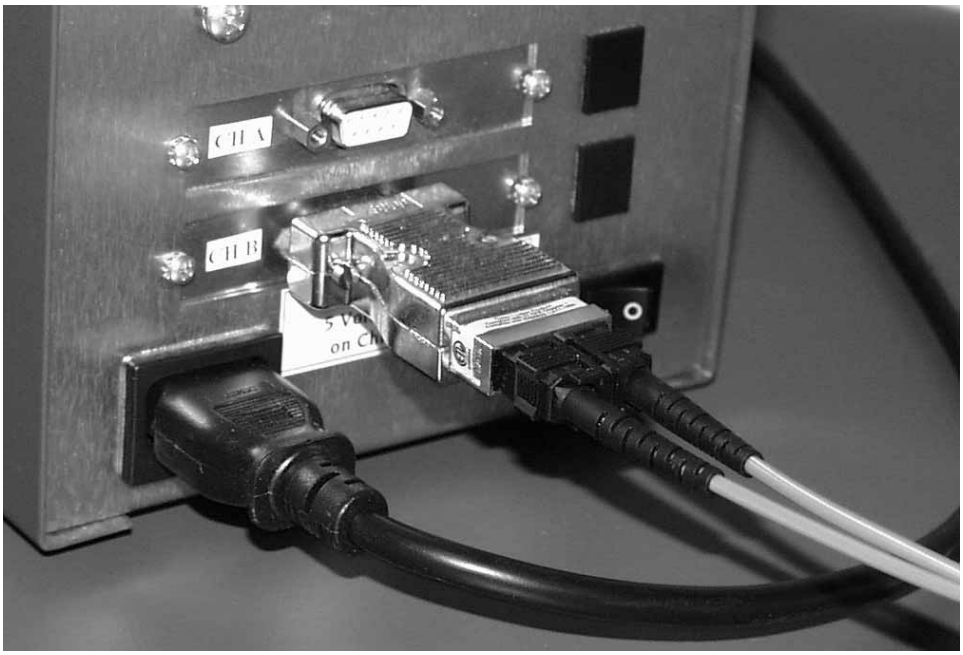


The adapter uses a laser diode to transform electrical signals into light signals and an optical sensor to perform the reverse function. The necessary electricity for the adapter must be delivered by the DB 9 connector. Compatibility with MIAs is an important point to consider when choosing FC devices. These adapters provide a very cost-effective method to connect FC devices which are located far from one another.

Example for a MIA and a SC fiber optics cable with a GDT7519RN

(MIA and fiber optics cable plugged into the female DB9 connector of the GDT7519RN)

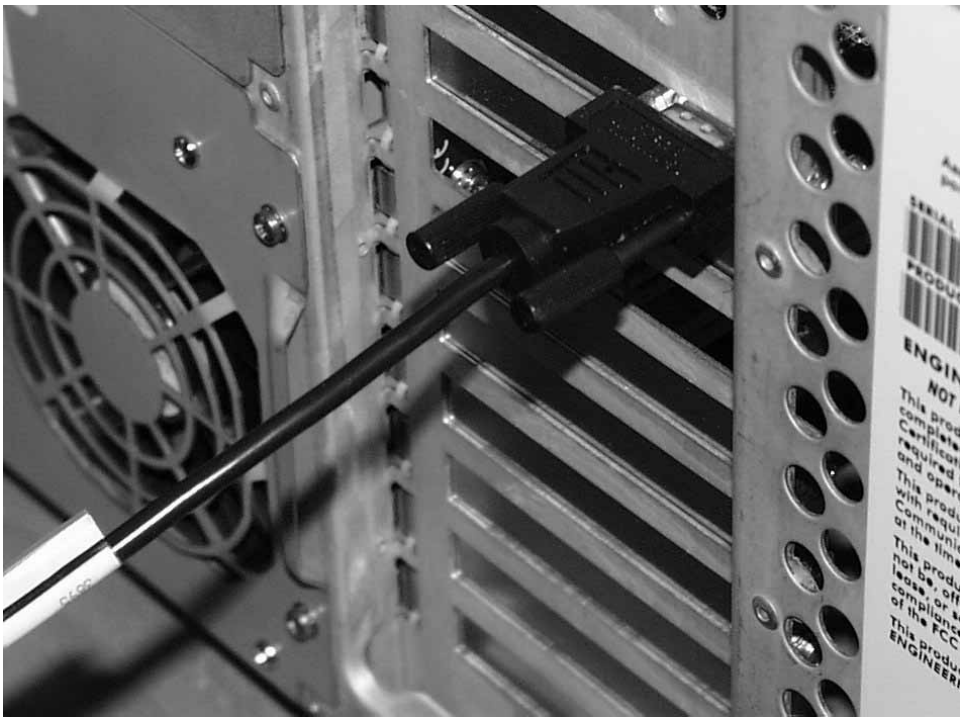




(MIA and fiber optics cable plugged into the female DB9 connector of the subsystem)

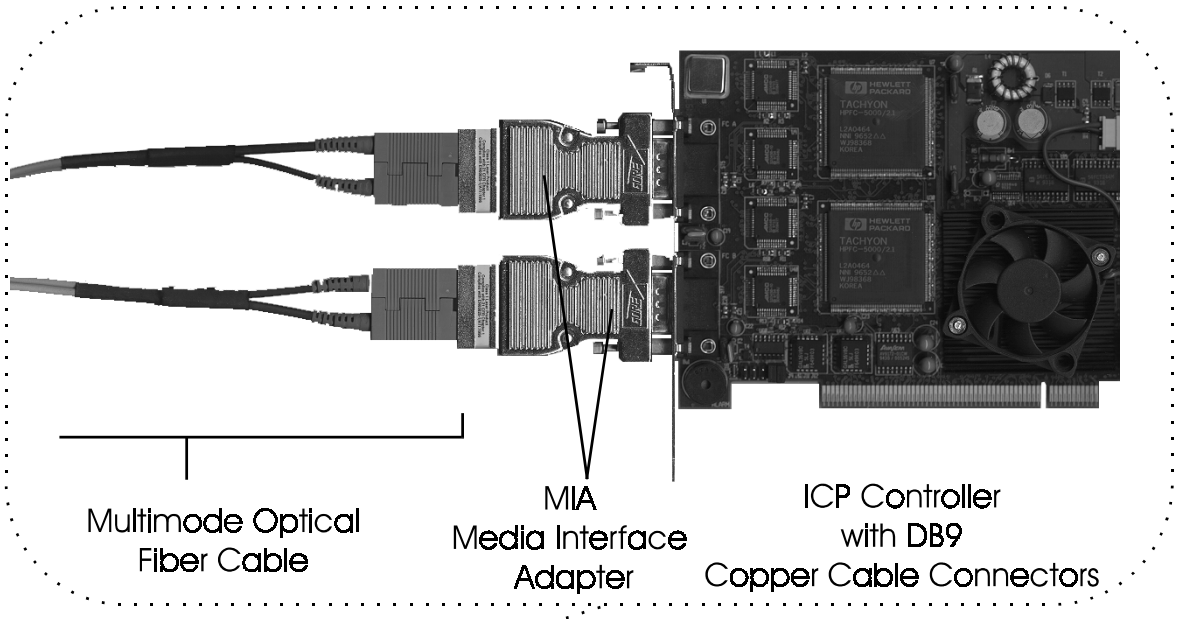
Example for a copper cable between a GDT7519RN and a FC-AL subsystem

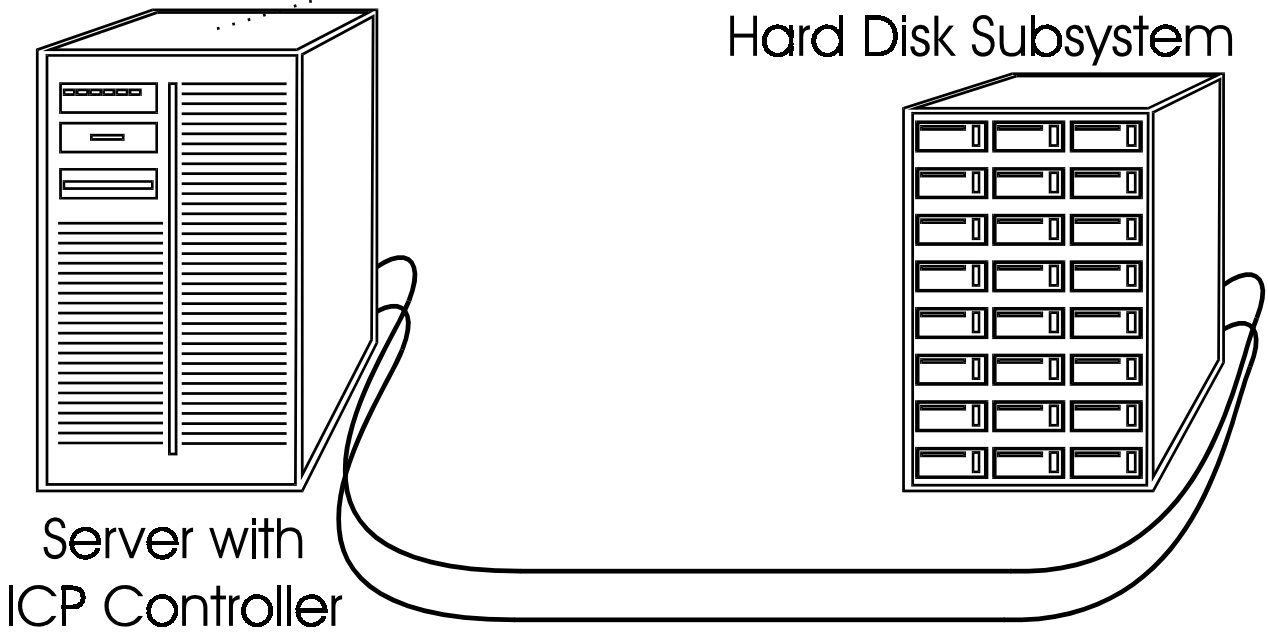
(DB9 connector of copper FC-AL cable plugged into the female DB9 connector of the GDT7519RN)



(DB9 connector of copper FC-AL cable plugged into the female DB9 connector of the subsystem)

Example for a Dual Loop Configuration





Two Fibre Channel Arbitrated Loops with
Multi mode optical fiber cables.
Up to 500 meters and 100MB/sec.
One loop can fail and the system continues to operate.

B.5 The Basics of SCSI

It is very important for you to observe the information and notes given in this section of the User's Manual because it helps to ensure that the SCSI devices that are used in connection with the ICP Controllers are operated in a successful, long-lasting and trouble-free manner. In many cases, these information are not only applicable to ICP Controllers, but in general to all those SCSI systems which, like the ICP Controllers, use *Single Ended* SCSI bus channels. According to its definition, the SCSI bus provides access to several participants that are physically connected through an appropriate SCSI bus cable. To achieve a sufficiently good signal quality, it is not only recommended to use very good cables and connectors, but also to terminate both ends of the cable properly. For an unambiguous identification on the bus, all participants have a unique number – the so-called SCSI-ID. Further details on these topics can be found on the following pages.
Please note that **98% of all SCSI-related problems are caused by bad SCSI cables, wrong SCSI bus termination and duplicate SCSI-IDs.**

B.5.1 SCSI Cables

The quality and overall length of the cable, as well as the number and quality of the SCSI connectors is very important for both internal and external SCSI cables. Generally, internal SCSI cables are 50 or 68 conductor flat ribbon cables. To connect external SCSI devices, round and shielded cables with appropriate connectors are typically used. The minimum cross section per line has been defined in the SCSI-3 specification as follows:

- 50 conductor cables: minimum 28 AWG conductors and with
- 68 conductor cables: minimum 30 AWG conductors.

The typical impedance of a SCSI cable is 84 Ohm +/- 12 Ohms. The maximum difference in impedance between two conductors of a SCSI cable must not exceed 12 Ohms. External round cables should have a SCSI-compliant placement of the inside conductors. Besides the cables, the right connectors for a cable are also very important. It is highly recommend to use highest quality connectors, only. The following table shows the maximum cable lengths allowed for a given transfer rate. Based on many years of SCSI experience, the lengths we recommend are in some cases shorter than theoretically possible. The information in the table refers to one SCSI channel and represent the overall length of the cable, including internal and external parts.

SCSI Bus Width	SCSI Mode	Synchronous Data transfer Rate	Number of Participants	Maximum Length
8 Bit, narrow	Fast	10 MB/sec.	8	2.0 m
8 Bit, narrow	Fast-20, Ultra	20 MB/sec.	4	1.5 m
16 Bit, narrow	Fast	10 MB/sec.	8	2.0 m
16 Bit, wide	Fast	20 MB/sec.	8	2.0 m
16 Bit, wide	Fast-20, Ultra	40 MB/sec.	4	1.5 m

With regard to Fast-20 devices, the maximum number of participants and the maximum cable length have to be strictly observed when a Fast-20 device (even if it is only one) is running in Fast-20 mode. In each case , the minimum cable length is 0.5 m. In addition to specifications mentioned above, the following should be kept in mind when selecting and installing SCSI cables:

- Always install SCSI cables that are as short as possible. The lengths in the table above are absolute maximum lengths. (Total length of internal and external cables per channel).

- Avoid using SCSI cables with more connectors than actually needed. Never select a SCSI mode or operate a SCSI device with a cable that is not appropriate for this mode.

- The minimum distance between two connectors of a SCSI cable is 20 cm.

- Avoid cable stubs. If this is not possible, keep the stub length below 10 cm.
  "Star cablings" are not allowed.

- Keep the number of transitions from flat to round cables and vice versa as small as possible. It is usually best is to use flat or round cables, only.

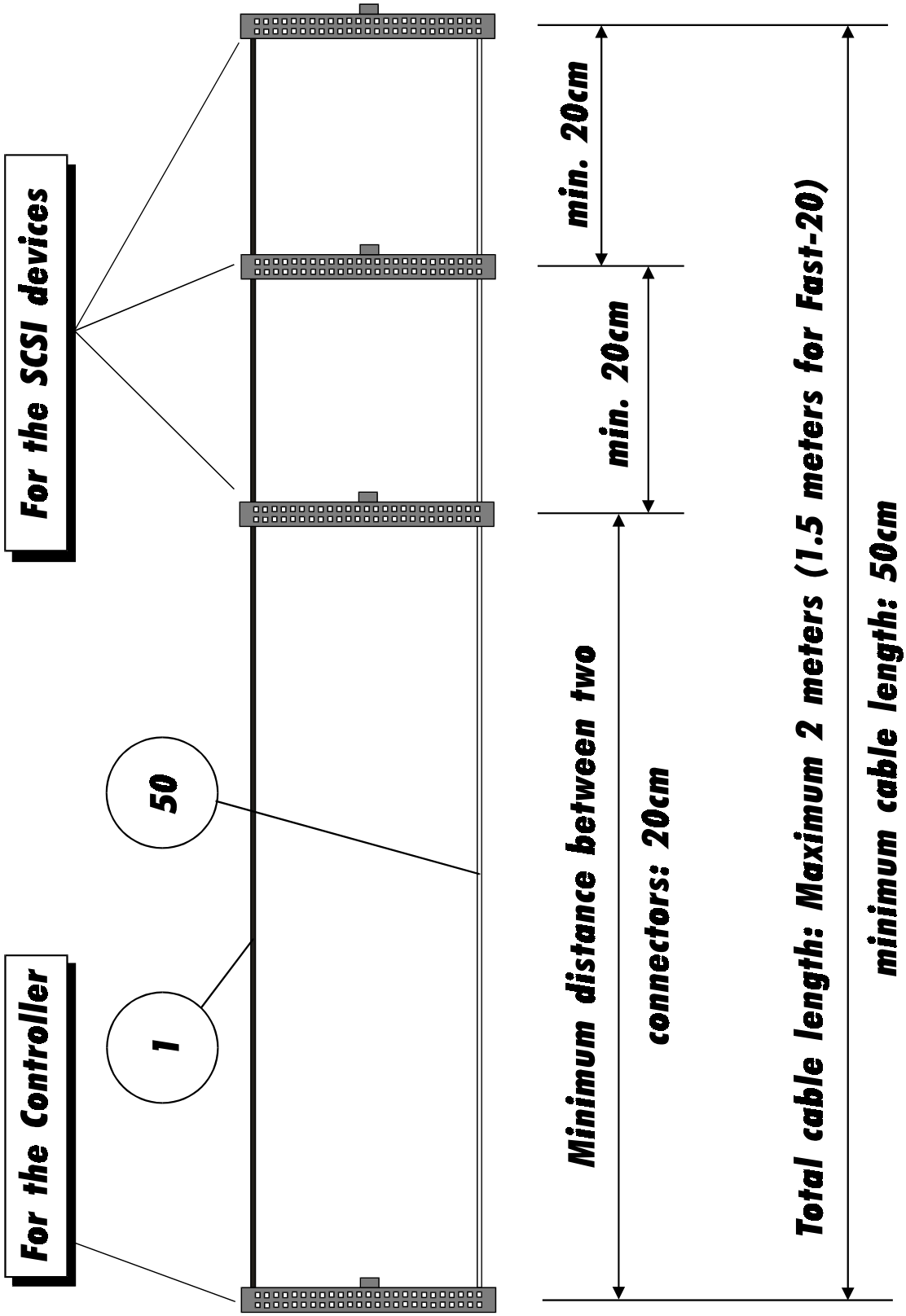
- Check these points when routing SCSI cables:
  - Avoid kinks in the SCSI cable
  - Do not roll the SCSI cable up on itself
  - Avoid routing the cable next to other cables
  - Avoid routing the cable in the vicinity of noise sources such as power supplies
  - Avoid routing the cable over sharp edges and in areas where it could get caught up
  - Avoid routing/sticking the cable directly onto metal surfaces

Following is a list of some manufacturers of high quality SCSI connectors and cables: 3M, AMP, Amphenol, Fujitsu, Harting, Honda, Methode, Molex, Robinson Nugent, Yamaichi.

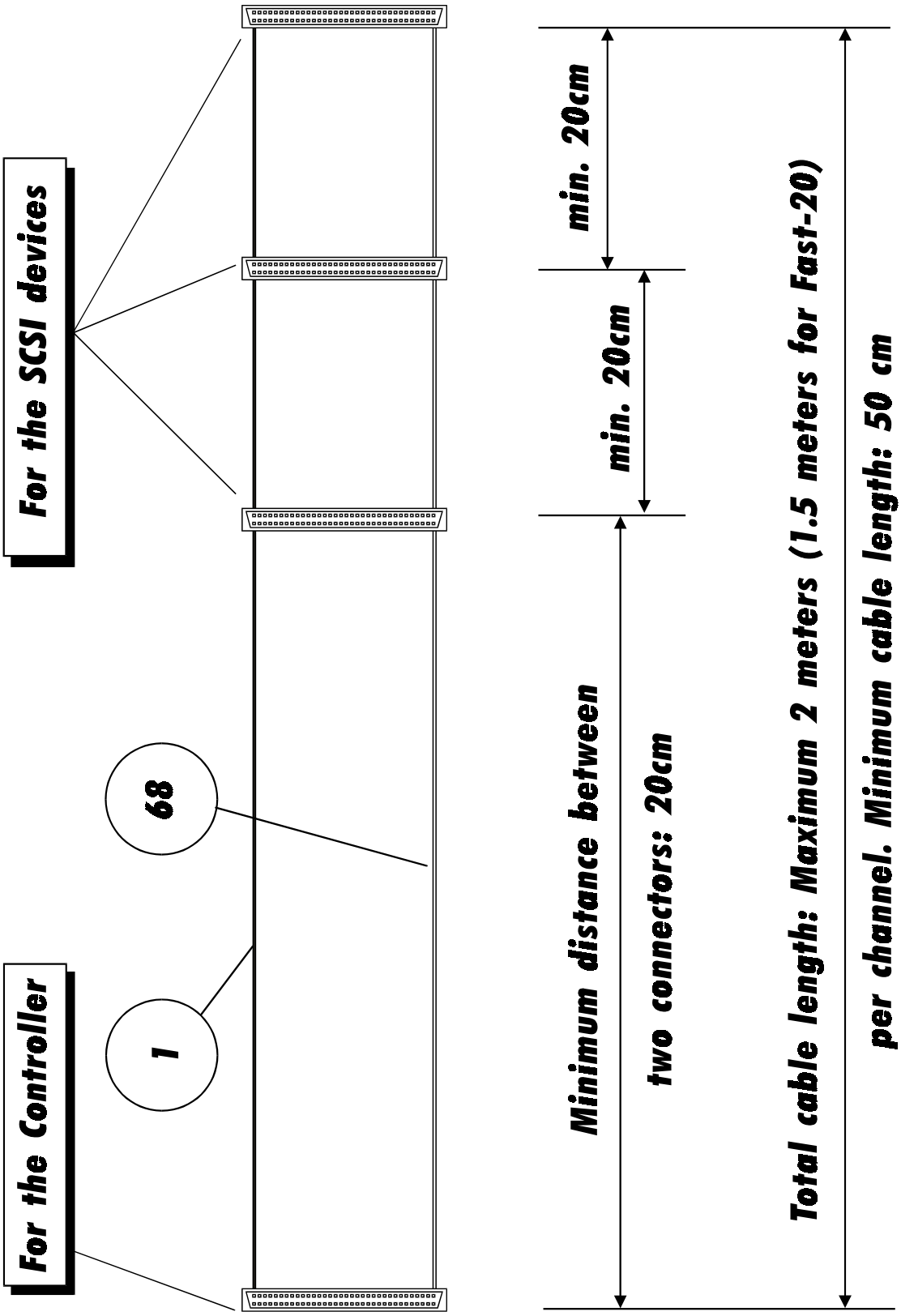
When making home-made SCSI cables, make sure that the insulation displacement connectors are properly aligned and firmly pressed into the flat ribbon cable. Otherwise, the whole cable might turn out to be a big short-circuit. Furthermore, check carefully that PIN 1 of the cable connects to PIN 1 of the connectors. A simple short-circuit and continuity test before running the devices helps you to save time and money.

The same warnings as for home-made cables apply when you buy non-brand cables. If you plan to run Fast-20 devices, you should explicitly ask your dealer if these cables are appropriate for the Fast-20 mode. (Note: The ICP product range also includes some high quality SCSI accessories. Along with external SCSI brackets, there is a special FAST-20 Wide SCSI cable. Please see section B.5.4 of this User's Manual or check our Website: http://www.icp-vortex.com, for further details).

Example for a SCSI Flat Ribbon Cable for 8 Bit SCSI Devices (narrow)



Example for a SCSI Flat Ribbon Cable for 16 Bit SCSI Devices (wide)



B.5.2 SCSI Termination

In order to ensure a flawless and interference-free signal transmission on the SCSI bus and to minimize the detrimental effects of external noise generators, both ends of the SCSI cable have to be terminated. The SCSI specification prescribes two alternative termination modes for Single-Ended SCSI bus systems: the passive termination and the active termination, also known as Alternative-2 termination. The passive termination consists of a 220 Ohm pull-up and a 330 Ohm pull-down resistor for each signal. Today, the passive termination is mostly used in systems with synchronous data transfer rates not exceeding 5 MB/sec, which is rather slow. The active termination circuit consists of a 110 Ohm precision-resistor per signal and a common 2.85Volt voltage regulator. Thus, all signals are actively pulled up to a certain level. The active termination provides much better signal quality and significantly reduced liability to noise. All ICP Controllers are equipped with an active SCSI bus termination. The voltage for the termination circuitry (passive and active) is supplied either by the SCSI device itself, or by the TERMPWR line of the SCSI bus. Every SCSI device, regardless of whether it is a hard disk, a printer, or an ICP Controller, must have a SCSI bus termination. In addition, it must be possible to enable and disable the SCSI bus termination (on some devices, resistor array packs or a jumper have to be removed, on others, like the ICP Controllers, soft-switches allow a very comfortable setting of the SCSI bus termination). Furthermore, on each SCSI device it must be possible (for example through a jumper) to switch the voltage on the terminator power line (TERMPWR) of the SCSI cable on or off. **For all configurations with ICP Controllers, we recommend that you use exclusively SCSI devices with an *active* SCSI bus termination**:

- Always use active SCSI bus termination.
- Do not use SCSI devices with passive SCSI bus termination (e.g., CDROMs) for the termination of the SCSI cable.
- Always terminate only the two ends of a SCSI cable.

The TERMPWR jumper (TP) on the ICP Controller PCB should always be set. In this way, it is the ICP Controller which supplies the termination power on the SCSI cable and no other SCSI device may supply termination power on the cable.
The connections listed in the table below are ***the only valid*** connections allowed. Any other connection setup, even if physically possible, is not allowed as it will cause serious malfunctions or even the destruction of the SCSI device and/or the ICP Controller. The termination settings can be changed within GDTSETUP.

Internal female connector, 68 pin	*Internal male connector 50 pin*	*Termination Setting of the ICP Controller*
Occupied and end terminated	Not occupied	On
Not occupied	Not occupied	On
Not occupied	Occupied and end terminated	On
Occupied and end terminated	Occupied and end terminated	Off
Not occupied	Occupied and both ends terminated, i.e., the connector is located between the both ends	Off
Occupied and both ends terminated, i.e., the connector is located between both ends	Not occupied	Off

B.5.3 SCSI ID

All participants on the SCSI bus must have a unique identification number, that is, each number can only be used once on a given cable. Each SCSI device is uniquely addressed through its SCSI ID.

- All participants of a SCSI bus must have a different SCSI ID.
- The factory set SCSI ID of the ICP Controller SCSI channel is 7.
- Up to 15 SCSI devices can be connected to a single SCSI bus. SCSI IDs are 0 to 15 (7 is the default for the ICP Controller).

On hard disks, CDROMs, tape streamers, etc., the SCSI ID is normally set through jumpers or small DIP switches. The ICP Controllers offer a far more comfortable method: software switches in the GDTSETUP program allow you to easily set the SCSI ID of an ICP SCSI channel. It is recommended to leave the default ID value at 7. Some operating systems require that the SCSI ID of certain SCSI device (e.g., tape streamer, CDROM) is set to a particular value (for more information, please refer to the appropriate chapter in this manual).

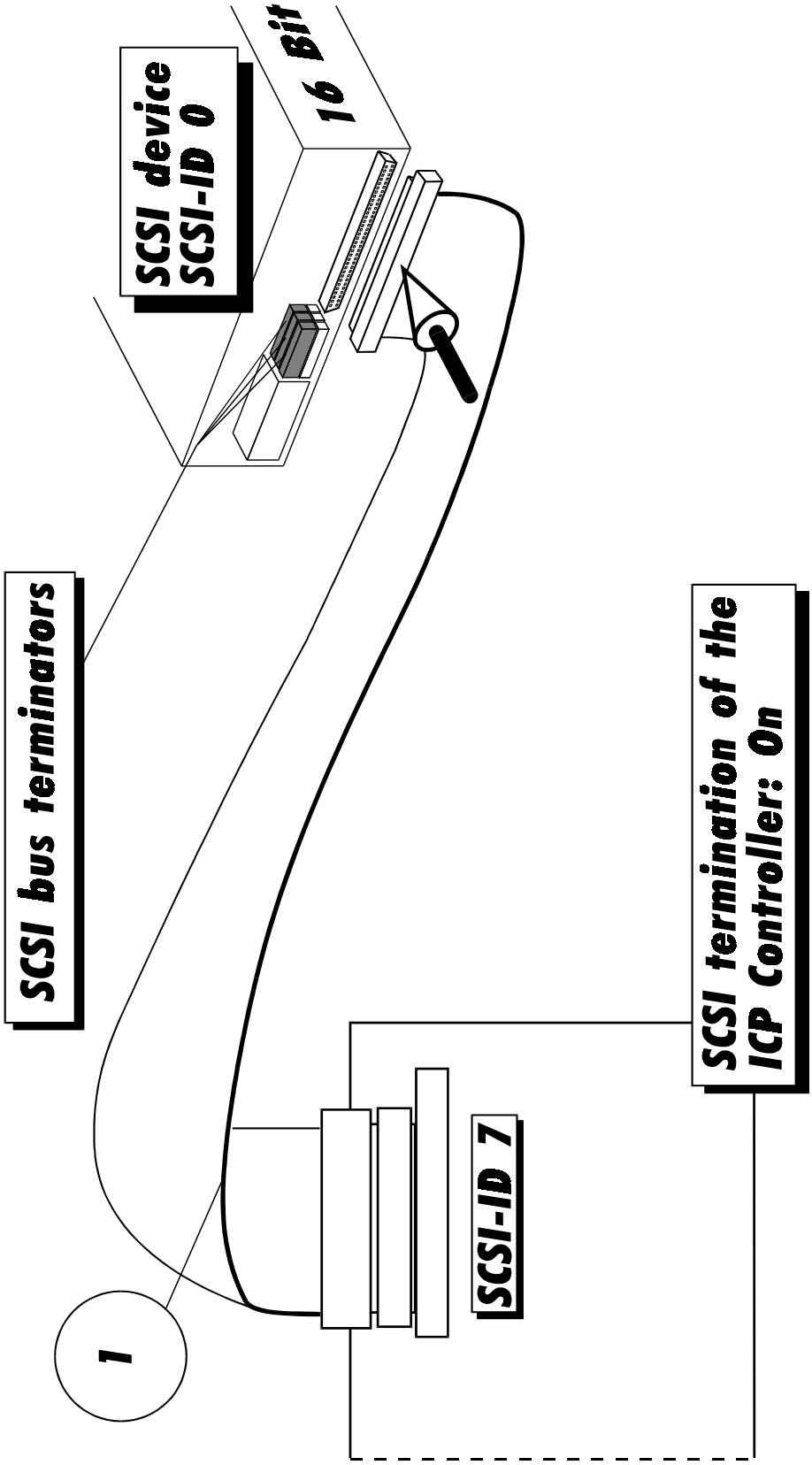
B.5.4 ICP SCSI Accessories

Order #	Part Name	Description	Application
8840	Fast-SCSI Bracket	External SCSI connector with an internal 50 pin header and an external 50 pin HD SCSI connector (female)	Connection of an external Narrow/Ultra SCSI subsystem with an internal Narrow/Ultra channel
8841	Wide-SCSI Adapter	16 Bit to 8 Bit SCSI adapter with a 50 pin header and a 68 pin HD SCSI connector (male)	Connection of Wide/Ultra SCSI devices with an 8 Bit 50 pin flat ribbon cable
8842	Wide-SCSI Bracket	External SCSI connector with an internal and an external 68 pin HD SCSI connector (female)	Connection of an external Wide/Ultra SCSI subsystem with an internal Wide/Ultra channel
8843	Wide/Ultra Flat Ribbon Cable	80 cm Wide/Ultra SCSI cable with four 68 pin HD SCSI connectors (male)	Connection of up to 3 internal Wide/Ultra SCSI devices per SCSI channel
8846	Narrow-Wide Bracket	External SCSI connector with an internal 68 pin connector (female) and an external 50 pin HD SCSI connector (female)	Connection of an external Narrow/Ultra SCSI subsystem with an internal Wide/Ultra channel

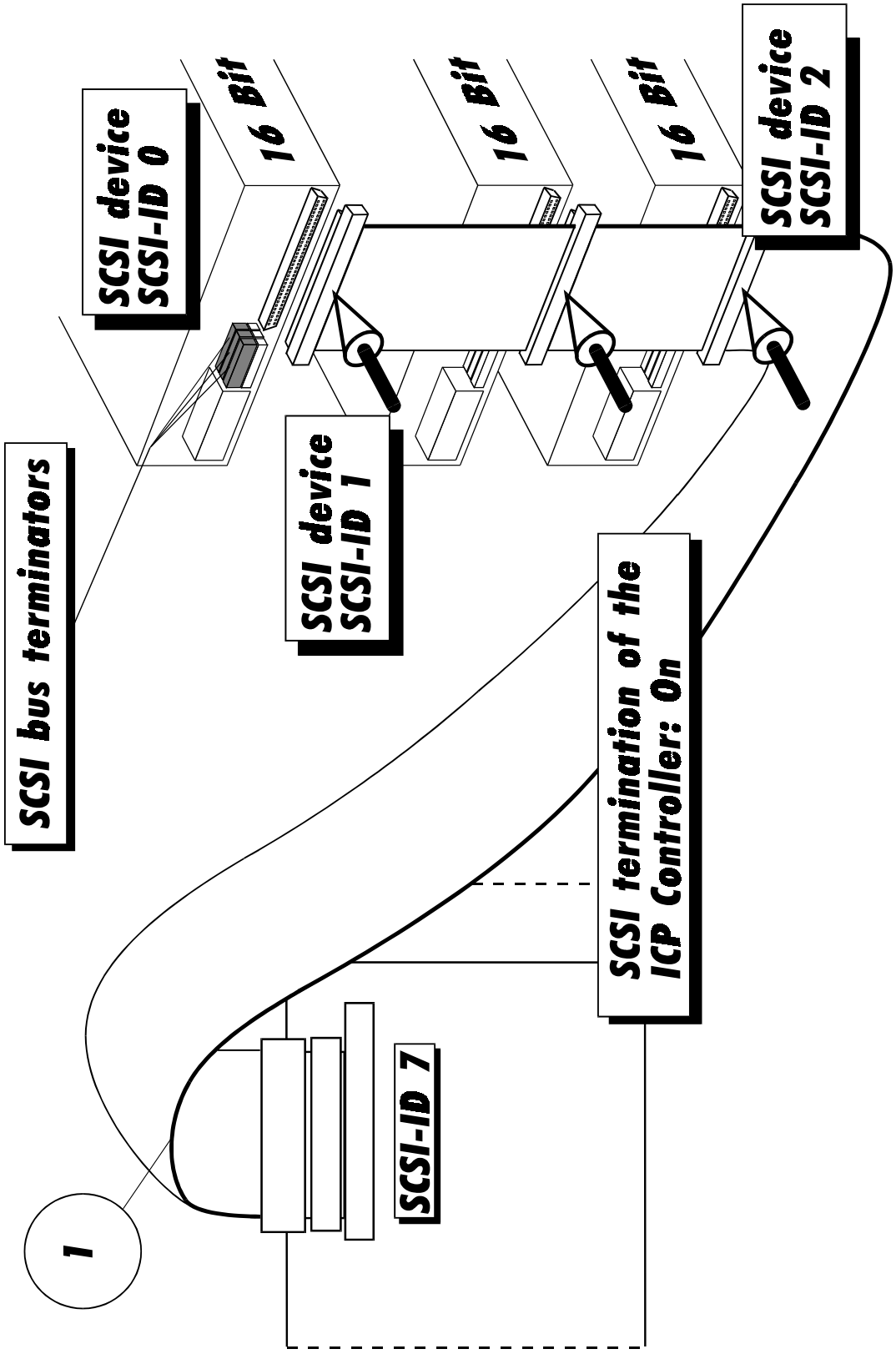
B.5.5 Examples

Following are some examples of correct SCSI cablings, SCSI terminations and SCSI-ID settings.

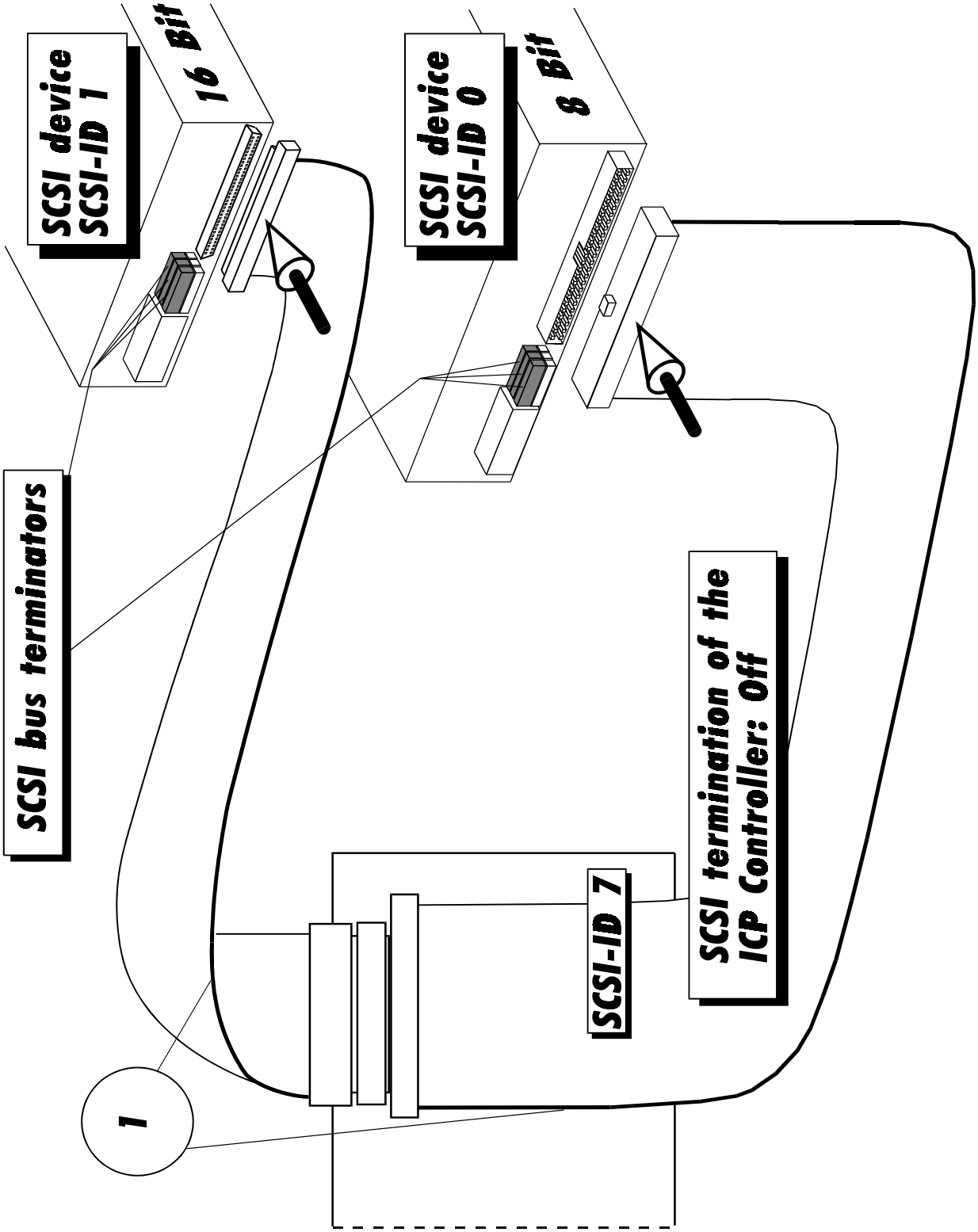
One Internal 16-Bit SCSI Device



Several Internal 16-Bit SCSI Devices



Two Internal SCSI Devices (16 Bit and 8 Bit)



B.6 ICP Controller Installation

Make sure that the ICP Controller is equipped with an appropriate DIMM (at least 8MB). As already mentioned in section B.3 of this User's Manual it is ***not*** possible to operate the ICP Controller without an ICP ECC-SDRAM-Module.

Step 1
Switch off the PCI computer system and remove all cables (first of all the power supply).

Step 2
Following the instructions in the computer manual, open the case of the PCI computer, so that you have easy access to the PCI expansion slots.

Step 3
Select a free **64 Bit PCI bus-master slot** and remove the metal bracket, following the instructions in your PCI computer manual. It is essential that the ICP Controller is plugged into a bus-master slot (it will NOT work in a slave or non-bus-master slot). Some motherboards have only 1 bus-master slot. Make sure that the selected slot has a sufficiently cooling airflow. Permanent overheating of electronic devices decreases their life time drastically. **The ICP Controller can be also operated in a 32 Bit PCI bus-master slot**. Make sure that the unused card-edge connector of the ICP Controller has no contact with other components in the PCI slot area. There are no further settings required to operate the ICP Controller in a 32 Bit or 64 Bit PCI bus-master slot.

Step 4
Push the ICP Controller firmly into the correct PCI bus-master slot. Make sure that the controller fits tightly into it, and that the external connectors stick out of the computer case. Now, fix the ICP Controller by tightening the screw of its bracket.

Step 5
To connect the Fibre Channel enclosure use either a copper round cable, or an optical fiber cable (with MIAs). Make sure that cables are fastened with the corresponding connectors. To connect internal SCSI devices, use the internal SCSI connectors of the ICP Controller. You need 50-pin or 68-pin SCSI flat ribbon cables with appropriate connectors. Please verify that the colored core of the SCSI flat ribbon cable connects PIN1 of the ICP SCSI connector to PIN1 of the SCSI device.

Step 6
If required, you can connect the HDD-front-LEDs of the PCI computer system to the LED connectors of the ICP Controller.

Step 7
Before the PCI computer system is switched on, check the following points over again:

- Have you installed an genuine ICP ECC-SDRAM-Module ?
  Is the ECC-SDRAM-Module into the socket ?
- Is the ICP Controller plugged firmly into one of the PCI bus-master slots ?
- Is the Fibre Channel enclosure properly connected with the ICP Controller.
- Are the SCSI-IDs set correctly ? Are the SCSI-bus terminators plugged/set correctly ?
  Are the SCSI flat ribbon cables connected correctly ?

Step 8
After having checked all the points in "Step 7", reconnect the PCI computer system to the power supply. Do not close the computer case yet.

B.7 ICP Controller Function Check

Before we put the ICP Controller into operation for the first time, we would like to spend a few words on the PCI 2.x compatibility requirements a PCI computer system (especially the motherboard and the motherboard's BIOS) should meet.

B.7.1 PCI 2.x Compatibility Requirements

A **pre-condition** for a flawless installation of PCI bus-master expansion cards (the ICP Controllers belong to this group of expansion cards) in a PCI motherboard is **a 100% PCI 2.x compatible System-BIOS**.

We have observed more than once that a motherboard declared fully PCI 2.x compatible was equipped with a System-BIOS (located in an EPROM or FLASH-RAM) which was not PCI 2.x compatible at all. To make up for this, many manufacturers of PCI motherboards or PCI computer systems offer their customers a special area on their website from where the latest PCI-system-BIOS version can be downloaded.

The System is fully PCI compatible.
If your PCI motherboard/computer is 100% PCI compatible, its PCI system-BIOS will, to a large extent automatically (*plug & play*), carry out the configuration (e.g., mapping of the ICP Controller's BIOS and DPMEM, assignment of a proper system IRQ to a PCI interrupt). This means that the PCI computer system (with its motherboard and PCI system-BIOS) must meet the following requirements:

1. The PCI computer system must automatically assign (map) the ICP Controller BIOS to an adequate address in the lower, 1MB area of the computer system's main memory.

2. The PCI computer system must map the ICP Controller's Dual Ported Memory (needed for high performance operation) to an adequate address in the lower, 1MB area of the computer system's main memory. In addition, it has to disable the shadowing of this address space.

3. Assigning a system IRQ to a PCI interrupt.
   The PCI 2.x specification prescribes 4 PCI interrupts, called INT A, INT B, INT C and INT D. A PCI interrupt must be assigned to a free (unused) IRQ of the PCI motherboard or computer. The ICP Controller is shipped with PCI INT A.

   Depending on the manufacturer of the PCI computer system, there two ways to carry out this task:

   - automatically (automatic IRQ routing)
   - with the PCI System-BIOS setup program

   Depending on the BIOS manufacturer (e.g., Award, Phoenix, AMI etc.), the setup program is activated by pressing a certain key-combination shortly after the reset (cold boot or warm boot). For detailed information on the key-combination and the jumpers' locations and settings, please refer to the system manual of your PCI motherboard or computer.

The System is not fully PCI compatible.
Problems may occur if the motherboard and/or System-BIOS are not fully PCI 2.x compatible. The best remedy is to update the PCI system-BIOS to the latest version.
Furthermore, we have integrated into our ICP BIOS various routines (*tricks*) which remedy the incompatibilities of some PCI system-BIOSes, at least with regard to the ICP Controller.

B.7.2 Switching On the PCI Computer System

Now, after having installed the ICP Controller and the devices, check whether the controller is working correctly. If the ICP Controller is the only controller in the computer system, set hard disks C: and D: to ***not available*** in the System-BIOS setup program of the computer.
Make sure that the boot priority starts with* A, *then* C, *etc..
Normally, you can start the BIOS setup program by pressing a certain key-combination after switching on the computer. After switching on the PCI computer system, pay attention to the LEDs of the ICP Controller.

- If everything is installed correctly, the green LED "S" will light up when switching on the PCI computer system. The green LED "S" (S for status) shows that the ICP Controller is online. If this green LED does not react as described above, switch off the PCI computer and double-check the correct installation of the ICP Controller.
- The electronic loudspeaker of the ICP Controller gives forth a series of 4 signals with a pause between the first two).
- The other green LED "T" may flicker sometimes (it always lights up during BUS-Master DMA transfers; the brighter it lights, the more DMAs).
- The yellow LEDs indicate accesses to the devices. They also may flicker occasionally as the ICP Controller scans the I/O channels for existing devices.

The ICP boot message appears. In the following example, a GDT7519RN Controller has been detected in PCI slot 3, and it has 32MB of ECC-SDRAM ("16 MB RAM detected..".). On the SCSI channel is a Quantum drive and a DLT2000XT streamer. On the Fibre Channel port four Seagate Barracuda drives are detected. They form one RAID-5 host drive.

```
GDT - PCI        Disk Array Controller BIOS                    Version 3.00
Copyright (C) 1991-98 by ICP vortex Computersysteme GmbH         Dec 7 1998
All rights reserved!
BIOS located at 0x000E0000 - 0x000E1FFF
1 Controller(s) found, Selftests OK, scanning I/O channels ...
[PCI 0/3] DPMEM at 0x000D0000 - 0x000D3FFF  INTA = IRQ10
[PCI 0/3] GDT7519RN -- HWL0 -- 32 MB SDRAM/ ECC -- 2048kB Flash-RAM
[PCI 0/3] Serial-No. 00123412 -- RAIDYNE-FW-Version 2.21.00-RFFF -- Dec 7 1998
[PCI 0/3] SCSI-A ID:0 LUN:0 -- QUANTUM  XP34300W
[PCI 0/3] SCSI-A ID:1 LUN:0 -- DLT2000XT
[PCI 0/3] Initializing Fibre Channel Link:
[PCI 0/3] FCAL-A: Fibre Channel Private Loop initialized
[PCI 0/3] FCAL-A ID:0 LUN:0 --  SEAGATE ST19171FC
[PCI 0/3] FCAL-A ID:1 LUN:0 --  SEAGATE ST19171FC
[PCI 0/3] FCAL-A ID:2 LUN:0 --  SEAGATE ST19171FC
[PCI 0/3] FCAL-A ID:124 LUN:0 --  SEAGATE ST19171FC
[PCI 0/3] RAID-5 Host Drive 1 installed (ready)


<<<  Press <CTRL><G> to enter GDTSETUP  >>>
```

The single messages have the following meaning:

BIOS located at 0x000E0000 - 0x000E1FFF
Unlike ISA or EISA computers where the BIOS address of a peripheral expansion card is set manually (ISA, jumpers) or with the help of a configuration file (EISA, cfg file) and the address space is determined by the user, the PCI system-BIOS automatically maps the BIOS of a PCI compatible peripheral expansion card to a memory address. At each cold or warm boot, it determines which address space to assign to the BIOS of an expansion card. The message shown above reports the physical address occupied by the ICP BIOS.

[PCI 0/3]
PCI device, bus system ***0***, slot ***3***. The PCI 2.x specification allows several PCI bus systems to be present in one PCI computer. All ICP Controllers have been designed to support multiple PCI bus system computers. The slot number indicated in the message above does not refer to the 3rd PCI slot, but indicates that the ICP Controller is plugged into a slot which is the third one the PCI chipset of the PCI computer can access. To determine which physical PCI slot this corresponds to, consult the system manual of your PCI computer.

DPMEM at 0x000D0000 - 0x000D3FFF INTA = IRQ10
DPMEM stands for ***D***ual ***P***orted ***MEM***ory. The ICP Controller needs this 16KB address space of the PCI Computer for the command communication. In our example, the address space begins at D000:0000 and ends at D000:3FFF (D000 is the segment address). As with the ICP Controller BIOS, this mapping, is also automatically carried out by the PCI system-BIOS. This information is essential when installing Expanded Memory Managers under DOS and Windows. The ICP DPMEM address space has to be excluded from the control of such a manager. (For more details, see chapter D of this manual). Furthermore, this messages tells us that the PCI ***INT A*** of the ICP Controller has been assigned to the system ***IRQ10***. This assignment, is also carried out automatically if the PCI system-BIOS is 100% PCI 2.X compatible.

GDT7519RN -- HWL0 -- 32 MB SDRAM / ECC - 2048kB Flash-RAM
GDT7519RN -- HWL0 stands for the type of ICP Controller found by the ICP BIOS. HWL means Hardware level. ***32 MB SDRAM /ECC*** indicates that the installed ECC module has 32MB. Depending on the size of the installed ECC-SDRAM-Module (ESM) the following messages are possible (xx = 16, 32, 64):

xx MB SDRAM/ECC xx MB ECC-SDRAM-Module

2048kB indicates the size of the installed Flash-RAM.

SCSI-A indicates the SCSI devices connected with the controller's separate Ultra Wide SCSI channel. ***FCAL-A or FCAL-B (with a GDT7x29RN)*** indicates the Fibre Channel devices connected with the controller's **F**ibre **C**hannel **A**rbitrated **L**oops.

<<< Press <CTRL><G> to enter GDTSETUP >>>
After pressing this hot-key, the message ***Entering GDTSETUP. Please wait...*** appears. The IO bus scan is completed and the built-in GDTSETUP configuration program is loaded. It allows you to configure RAID Array Drives.

B.7.3 Trouble Shooting

If these messages do not appear on the screen, or if other problems occur after switching on the computer system (screen remains dark etc.), you should check the entire installation over again:

- Are you using a genuine ICP ECC-SDRAM-Module (ESM) ?
  Try another one.
- ESM plugged firmly into the socket ?
  Unplug it and plug it in again.
- Is the ICP Controller plugged into a PCI bus-master Slot ?
  Check this. If necessary, try another slot.
- Is the Fibre Channel cable OK ?
  Check length and connectors. Try another cable.
- Is the SCSI cable OK ?
  Check the length and connectors, Try another cable..

If the **PCI System-BIOS is not PCI 2.x compatible** (see above), the ICP Controller BIOS may display one or more of the following messages:

(i) The DPMEM has not been installed correctly.

Error: ***System-BIOS not PCI compliant (contact your mainboard supplier)***
Controller at x/y has invalid DPMEM address 012345.
Trying to allocate a free address.
Found free address at 678901, accept ? (Yes/No/Abort) Y
(Caution: this address must not be used by another expansion card !)

In this case, the system-BIOS has not installed the Dual Ported Memory of the ICP Controller correctly. Therefore, the ICP Controller will search for an adequate address. If you accept the suggested address (***Y***), the ICP Controller will install its DPMEM starting at this address. Since this 16KB address space which starts at ***free address*** must not be shadowed, you might have to disable the shadowing manually in the system-BIOS setup program. In addition, make sure that this address space is not used by another expansion card. (This is a work-around, not a solution. PCI 2.x is a well defined specification, and a fully compatible system-BIOS should have assigned the DPMEM automatically.)
If the ICP BIOS could not find an appropriate address, the following message is displayed:

Cannot set DPMEM address, aborting

In this event, you can try to select a new address after resetting the computer. If this fails, too, there is no other way but to update the PCI system-BIOS.

(ii) The IRQ to PCI INT assignment doesn't work properly.

Warning: ***controller at x/y, System BIOS configured IRQ Z, but uses U***

This warning indicates a bug in the PCI System-BIOS, too: It did not succeed in correctly assigning an IRQ to a PCI INT. The ICP Controller will function, but the ICP BIOS must not be disabled whatsoever.

(iii) The IRQ to PCI INT assignment doesn't work at all.

Error: ***controller at x/y could not read IRQ setting***

If this error message is displayed, the ICP Controller will not work.

In all these cases you should - in case (iii) you have to - update your PCI system-BIOS as soon as possible.

B.8 Checking the ICP Controller Configuration

As mentioned before, these settings can be changed through soft-switches in the ICP Controller setup program GDTSETUP. All settings are permanently stored on the ICP Controller. The following table shows the various options and the possible settings.

Function	*Possible Settings*	*Factory Setting*
Cache On (*)	On, Off	On
Delayed Write On (*)	On, Off	On
BIOS	Enabled, Disabled, Removed (**)	Enabled
BIOS Warning Level	All messages, Fatal errors	Fatal errors
Supported BIOS Drives	2,7	7
Memory Test	No Test, Standard, Double Scan, Intensive	Standard
SCSI-ID SCSI-A	0,1,2,3,4,5,6,7	7
SCSI Termination	On, Off, Auto	Auto

(*) Can also be changed with the GDTMON or ICP RAID Navigator online utilities.
(**) Only with GDTSETUP under MS-DOS.

B.8.1 Loading GDTSETUP

As already mentioned before, there are two different possibilities to load GDTSETUP. Basically, these two possibilities are based on two different variants of the same program: One which is integrated into the FLASH-RAM of the ICP Controller and another with is simply an EXE program loadable under MS-DOS.
Loading GDTSETUP from the FLASH-RAM is very comfortable, since it requires nothing else, but pressing the <CTRL><G> key combination after switching on the PC.
Loading GDTSETUP under MS-DOS becomes necessary, when you want to use GDTSETUP's integrated partitioning functions, or when you have totally disabled the ICP's BIOS (which includes the GDTSETUP variant loadable from FLASH-RAM).

If you want to load GDTSETUP under MS-DOS you have to load the device driver GDTX000 first. This can be done in two ways:

1. Starting the device driver from the DOS-command level by typing GDTX000<ENTER>

2. Starting the device driver automatically by means of the CONFIG.SYS (DEVICE=GDTX000.EXE)

Note: GDTSETUP as well as GDTX000 are on the ICP CDROM.
The header of the GDTSETUP program indicates with a letter after the version number, whether GDTSETUP was loaded from disk or from Flash-RAM:

"**R**" for GDTSETUP loaded from the Flash-RAM after switching on the computer
"**D**" for GDTSETUP loaded from Disk, i.e., under MS-DOS.

The main menu appears. *Select Controller*.

Select the ICP Controller and press <ENTER>.

Press the <F2>-key for the Advanced Setup.

Select C*onfigure Controller* and press <ENTER>.

The fields can be selected by moving the cursor keys ↑ and ↓ . The values can be changed by pressing <ENTER> and selecting a new setting. Leave this menu by pressing the <ESC>-key. In order obtain optimum performance from your ICP Controller, it is essential that the *Cache* and the *Delayed Write* options of the ICP Controller are set ***ON***, too. If you should find different settings here, we recommend that they be changed now.

B.8.2 Updating the ICP Controller With New Firmware and BIOS Versions

The firmware, the BIOS and the GDTSETUP program of the ICP Controller are stored in a Flash-RAM which is part of the ICP Controller hardware. In contrast to EPROMs, Flash-RAMs can be re-programmed many times and without the complicated UV-light erasing procedure. Thus, both software modules can be easily updated without having to remove the controller from its PCI slot. Firmware and BIOS are part of the ***GDT_RPFW*** file. The file has an extension (e.g., GDT_RPFW.009) which indicates the version stepping. The latest version of the this file can be downloaded either from our 24h BBS (+49-(0)-7131-5972-15) or from our Website http://www.icp-vortex.com. We recommend that you also download the packed files which contain the latest programs/drivers for the operating system used on your system. Observe the following order when carrying out the updating procedure:

1. Get the latest GDT_RPFW file for the ICP Controller (download it from our BBS, or our Website, or ask for an upgrade disk if you do not have a modem). The file does NOT need to be expanded !

2. Format a 3.5" HD disk (1.44MB) and copy the GDT_RPFW file on this disk.

3. After loading GDTSETUP (from Flash-RAM or from disk under MS-DOS) select the desired ICP Controller for the firmware update and press the <F2>-key to enter the Advanced Setup.

4. Select *Configure Controller* and thereafter F*irmware U*p*date*. Insert the disk with the firmware file into drive A. GDTSETUP loaded from the Flash-RAM will display a list of the valid files found on the disk. If you have loaded GDTSETUP from disk you have to enter the path "A:", first.

5. The update process starts as soon as the desired GDT_RPFW file has been selected. Strictly observe the messages and instructions of GDTSETUP. It is extremely important that the system is not switched off or reset during the update process. It is very likely that this would cause the ICP Controller to become inoperable.

The new versions of the ICP Firmware, the BIOS and GDTSETUP are available after the next cold-boot. All user-setting within GDTSETUP remain valid after the update process.

B.8.3 Additional Notes

Before the computer is switched off or a hard reset is carried out, the* ICP Controller *first has to write the current contents of its cache* RAM *back to the hard disk(s) (flush). The computer may only be switched off or reset after all hard disk accesses have been completed. If this is not observed there is a high risk of data corruption and data loss ! A good indication for hard disk activity is the front HDD-LED of your computer system (presuming it is connected with the corresponding pin grid header of the ICP PCB). In addition, all ICP drivers (i.e. for all supported operating systems) are designed to perform a cache flush when a regular system shutdown is initiated (e.g., Under NetWare: *Down* and *Exit*; Under DOS: CTRL-ALT-DEL; Under UNIX: *Shutdown*). They will show a message similar to the following "*Flushing Controller Cache*". As long as this message is displayed you must not switch off or reset your PCI computer. For Windows 95, Windows NT and OS/2 you may switch off or reset the computer as soon as the operating system message is displayed, which indicates that it is safe, to turn off the computer now.

The RISC CPU of the ICP Controller is equipped with a cooler. The cooler keeps the operating temperature of the CPU within the specified limits. The air intake is on the top of the fan. The air flows through the fins of the heat sink and leaves it on the left and right side. In addition, it is necessary that the whole ICP Controller is positioned in a constant airflow. Normally, good server enclosures have extra fans for the motherboard expansion slot area. In case of over temperature, the ICP Controller sends a message to the operator.
The cooler on your* ICP Controller *may look different from the one on pages of this manual. Depending on the type of i960 Rx CPU installed on the* ICP Controller*, with some models, the cooler is completely missing. This is intended !
***All variants fully comply to the specifications laid down in this* User's Manual.**

Chapter C

Quick-Setup

Intelligent Computer Peripherals ®

ICP

C. Quick-Setup

C.1 What is the Aim of Quick-Setup ?

In the previous chapter we installed the ICP Controller in a PCI computer and connected the SCSI and FCAL devices. Now these devices must be prepared in order to run with your operating system. This **Quick-Setup** chapter should help you to get started quickly. Quick-Setup shows **four examples** on how a single hard disk, a Mirroring Array Drive (RAID 1), a RAID 5 Array Drive and a RAID 5 Array Drive with a Hot Fix drive are installed:

Example 1	Installing a single hard disk.
Example 2	Installing a Mirroring Array Drive (RAID 1), consisting of 2 hard disks.
Example 3	Installing a RAID 5 Array Drive, consisting of 3 identical hard disks.
Example 4	Installing a RAID 5 Array Drive, consisting of 3 identical hard disks, and adding one Hot Fix hard disk.

With examples 3 and 4 some essential issues having direct impact on the structure and configuration of an Array Drive will also be discussed:

1. How many physical hard disks are to be integrated in the Array Drive ?
2. Which redundancy level ought to be achieved ?
3. Should the ICP Controller automatically recover redundancy in the event of a disk failure ? Or, in other terms: Are Hot Fix drives needed ?

Before we go through these examples step by step, we would like to explain a few terms and relations important for the basic understanding of the ICP Controller firmware. At the end of example 4, we will try to answer the three questions above.

C.2 What is the ICP Controller Firmware ?

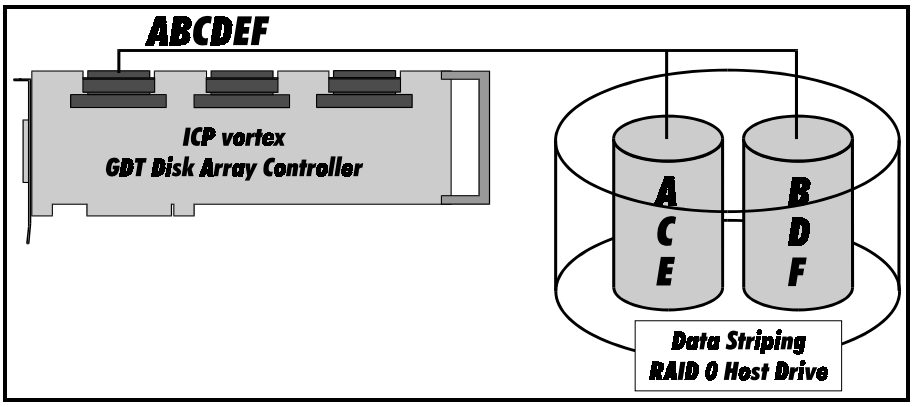
We refer to firmware (RAIDYNE®) as the operating system which controls the ICP Controller with all its functions and capabilities. The firmware exclusively runs on the ICP Controller and is stored in the Flash-RAM on the ICP Controller PCB. The controlling function is entirely independent of the PCI computer and the host operating system installed (for example UNIX), and does not "drain" any computing power or time from the PCI computer. In addition to disk chaining, RAID 0 and RAID 1, the firmware allows you to install and control Array Drives of the types RAID 4 (data striping with dedicated parity drive), RAID 5 (data striping with distributed parity) and RAID 10 (a combination between RAID 0 and 1). All ICP Controllers are equipped with a hardware which is particularly well suited for disk arrays. RAIDYNE® uses this hardware with extreme efficiency and therefore allows you to configure disk arrays that do not load the host computer (whereas all software-based RAID solutions more or less reduce the overall performance of the host computer.).

The basic concept of the RAIDYNE® is strictly modular, and consequently, in its functioning it appears to the user as a unit construction system.

C.2.1 The Different RAID Levels

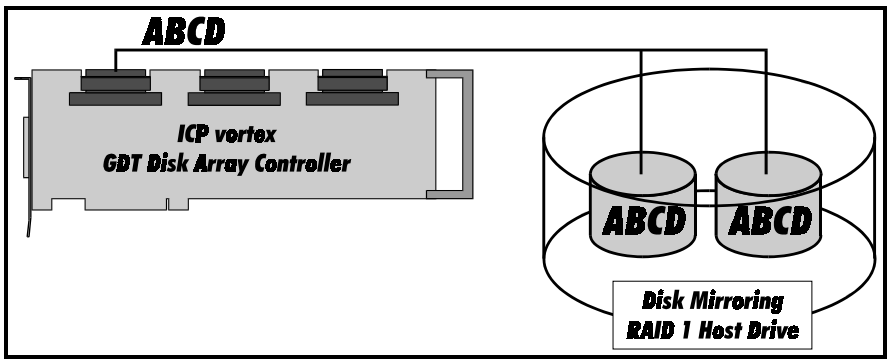
RAID 0 - Data Striping

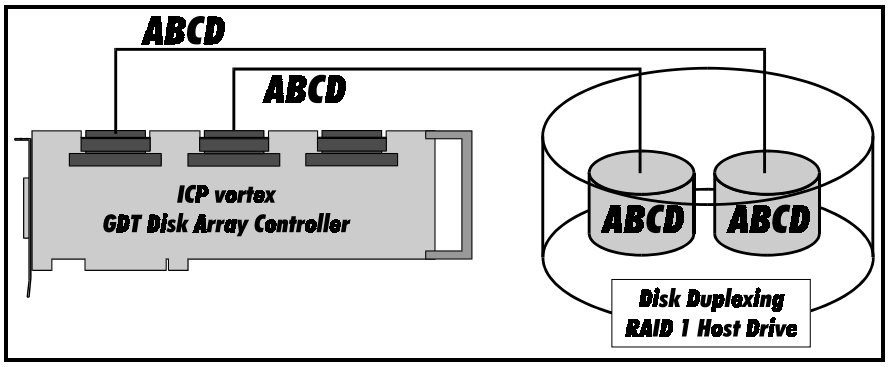
According to the adjusted stripe size (e.g., 16 KB) and the number of hard disks, the data blocks are split into stripes. Each stripe is stored on a separate hard disk. Especially with sequential read and write operations, we can observe a significant improvement of the data throughput. RAID 0 includes no redundancy at all, i.e., when one hard disk fails, all data is lost.



RAID 1 - Disk Mirroring/Disk Duplexing

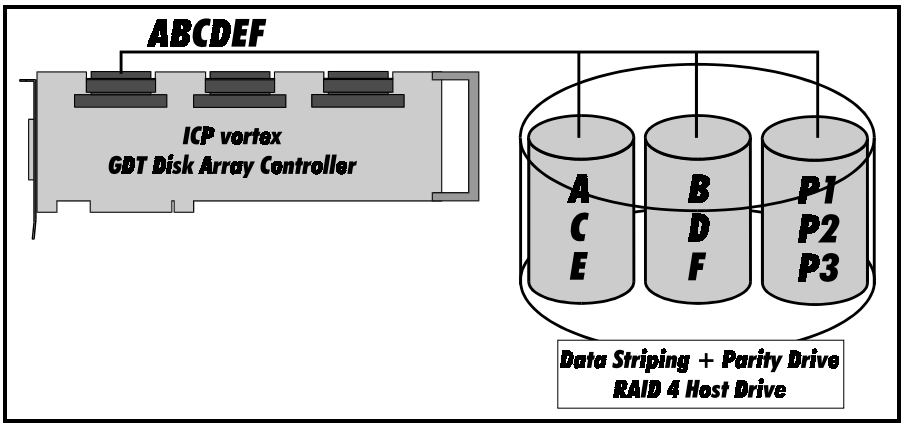
All data is stored twice on two identical hard disks. When one hard disk fails, all data are immediately available on the other without any impact on the performance and data integrity.
We talk about "Disk Mirroring" when two hard disks are mirrored on one I/O channel. If each hard disk is connected with a separate I/O channel, this is called "Disk Duplexing" (additional security).
RAID 1 represents an easy and highly efficient solution for data security and system availability. It is especially suitable for installations which are not too large (the capacity available is only half of the installed capacity).





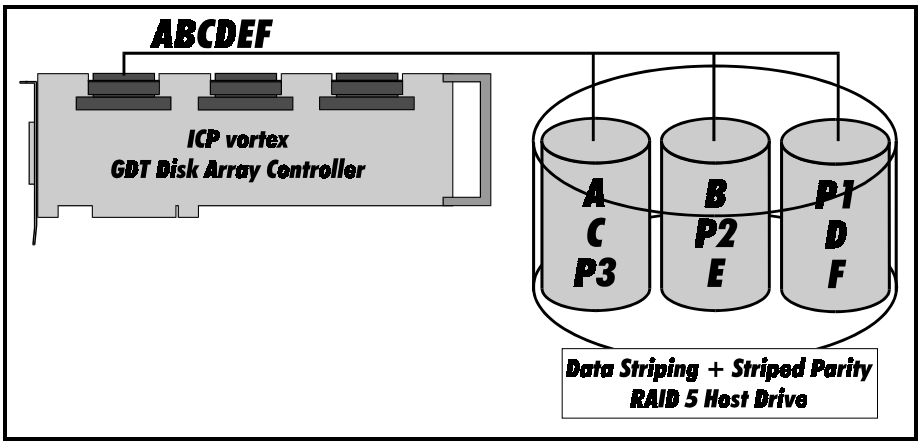
RAID 4 - Data Striping With a Dedicated Parity Drive

RAID 4 works in the same way as RAID 0. The data are striped amongst the hard disks. Additionally, the controller calculates redundancy data (parity information) which are stored on a separate hard disk (P1, P2, ...). Even when one hard disk fails, all data are still fully available. The missing data is recalculated from the data still available and the parity information. Unlike in RAID 1, only the capacity of one hard disk is needed for the redundancy. If we consider, for example, a RAID 4 disk array with 5 hard disks, 80% of the installed hard disk capacity is available as user capacity, only 20% is used for redundancy. In situations with many small data blocks, the parity hard disk becomes a throughput bottle-neck. With large data blocks, RAID 4 shows significantly improved performance.



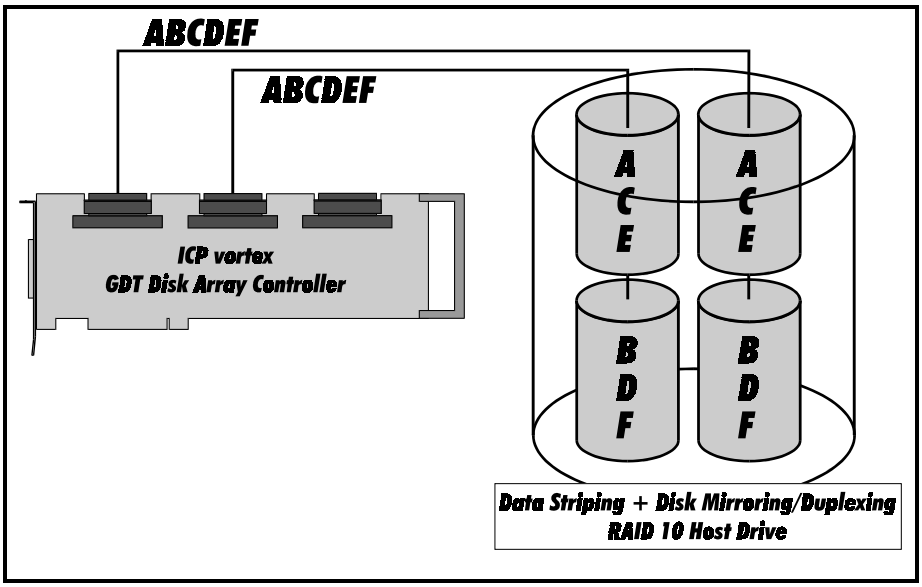
RAID 5 - Data Striping with Striped Parity

Unlike RAID 4, the parity data in a RAID 5 disk array are striped in all hard disks. The RAID 5 disk array delivers a balanced throughput. Even with small data blocks, which are very likely in a multi-tasking and multi-user environment, the response time is very good. RAID 5 offers the same level of security as RAID 4. When one hard disk fails, all data are still fully available, the missing data are recalculated from the data still available and the parity information. RAID 4 and RAID 5 are particularly suitable for systems with medium to large capacity requirements, due to their efficient ratio of the installed and actually available capacity.



RAID 10 - Combination of RAID 1 and RAID 0

The idea behind RAID 10 is simply based on the combination of RAID 0 (Performance) and RAID 1 (Data Security). Unlike RAID 4 and RAID 5, there is no need to calculate parity information. RAID 10 disk arrays offer good performance and data security. As in RAID 0, optimum performance is achieved in highly sequential load situations. Identical to RAID 1, 50% of the installed capacity is lost for redundancy.



C.3 How are the ICP Firmware Features Activated ?

Any installation or maintenance procedures regarding the ICP Controller should be carried out with the configuration program **GDTSETUP**. The monitoring programs **GDTMON** (character oriented tool) and **ICP RAID Navigator** (GUI tool) allow a continuous monitoring and maintenance of the ICP Controller and the connected disk arrays. These utilities also includes options to replace a defective drive with a new one (Hot Plug) and is available for most of the operating systems supported by the ICP Controllers. GDTSETUP allows you to set up single disks or complex disk arrays with simple and user-friendly installation procedures. Little previous knowledge is needed to be able to use GDTSETUP efficiently. It is only necessary to understand the hierarchy levels in the ICP Controller firmware.
For the user's convenience the GDTSETUP program is available in two different variants:

- GDTSETUP loaded from the ICP Controller's Flash-RAM after switching on the computer
- GDTSETUP loaded from disk under MS-DOS.

The header of the GDTSETUP program indicates with a letter after the version number whether GDTSETUP was loaded from disk or from Flash-RAM:

"**R**" for GDTSETUP loaded from the Flash-RAM after switching on the computer
"**D**" for GDTSETUP loaded from Disk, i.e., under MS-DOS.

Loading GDTSETUP with <CTRL><G> from the Flash-RAM is very comfortable since no operating system is required to carry out the configuration and setup works.

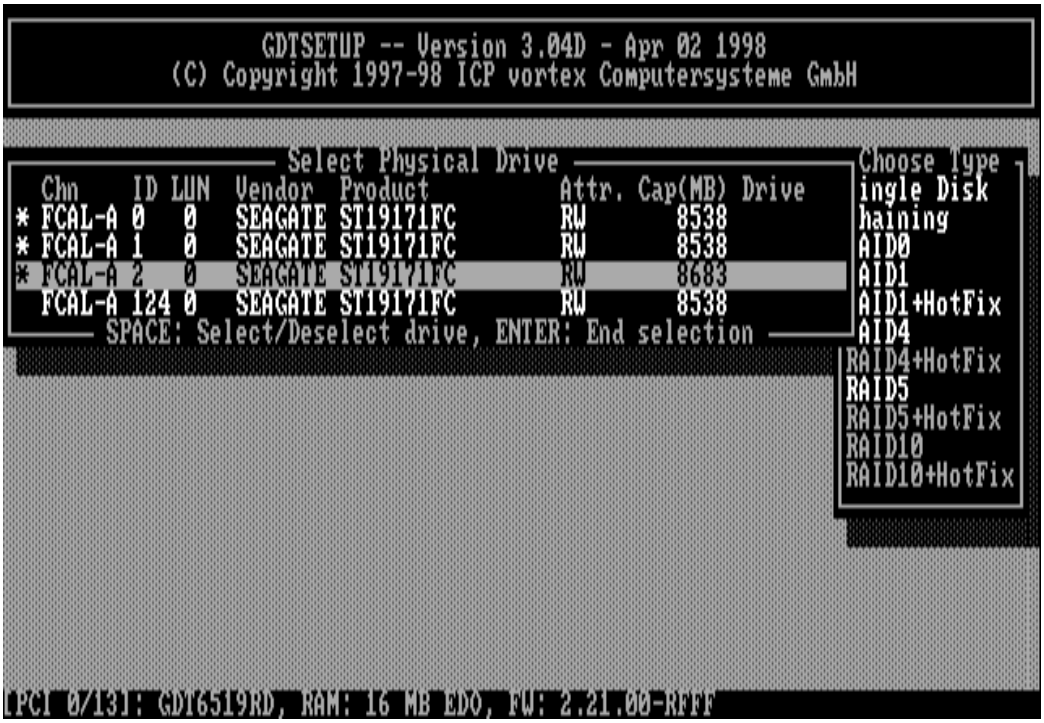
On the other side, loading GDTSETUP from disk (i.e., under MS-DOS) becomes necessary for tasks like partitioning or enabling a totally disabled ICP BIOS (which includes GDTSETUP).

C.3.1 The Express Setup Function of GDTSETUP

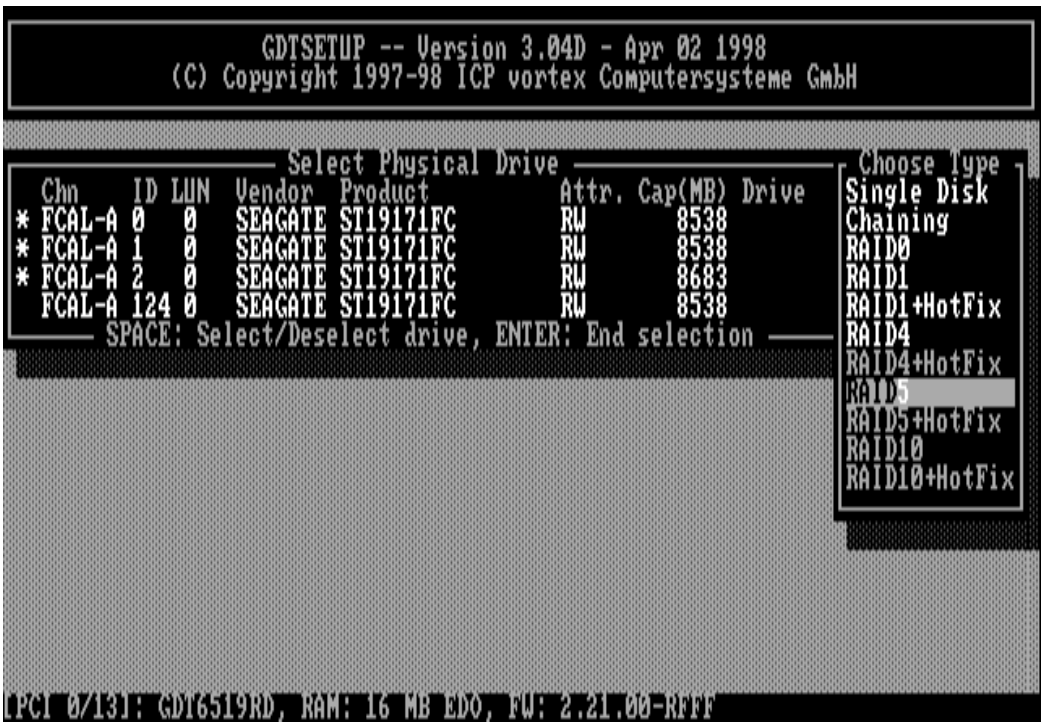
Whenever you load GDTSETUP and select the desired ICP Controller, it comes up in its EXPRESS Setup mode. This mode does not require any previous knowledge. If you choose this function, GDTSETUP carries out the complete installation entirely on its own, providing you for example with a fully operational RAID 5 Array Drive with optimized settings (for instance, with all features of a given drive activated).

After selecting C*onfigure* H*ost* D*rives*, select C*reate new* H*ost* D*rive*.

GDTSETUP scans the system for "free" hard disks (i.e., drives which are not yet part of other Host Drives). Use the <SPACE>-bar to select the desired hard disks (they are marked with an "*"). On the right side GDTSETUP offers highlighted the possible configurations with these drives.

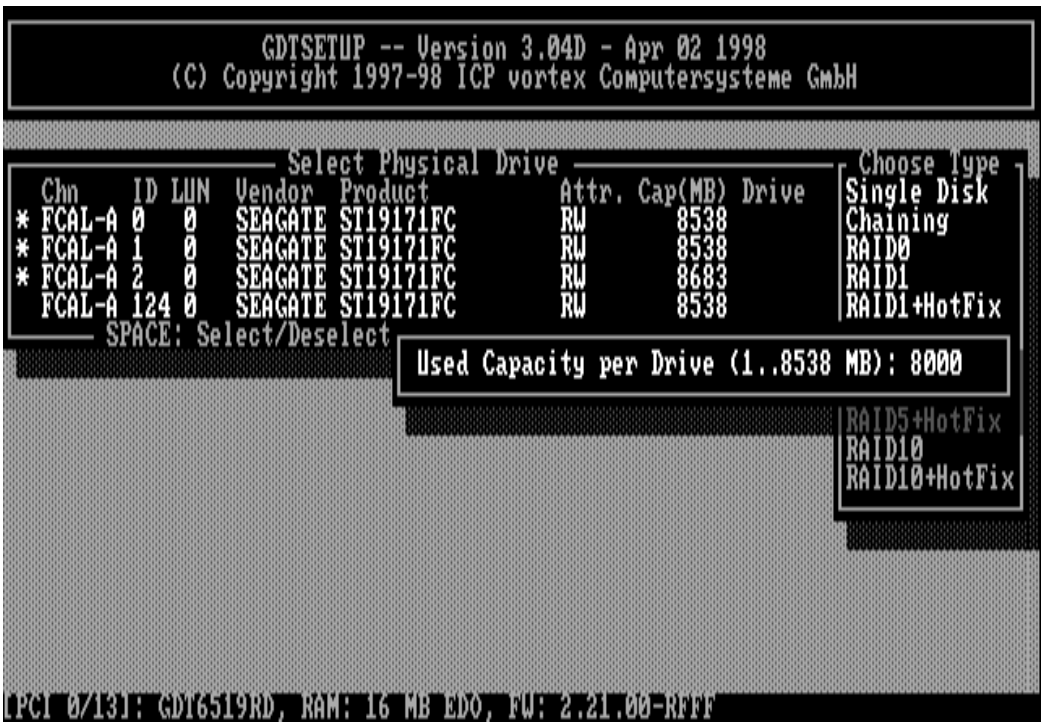


Pressing <ENTER> ends the selection.



After choosing a configuration type for an Array Drive, GDTSETUP displays a security request.

After this confirmation you can adjust the capacity per drive used for the disk array.



Express Setup delivers a fully operational RAID5 disk array.
After leaving GDTSETUP the parity information is generated.

For chapter C, we do not use this function, but give detailed instructions on how to set up a single disk and disk arrays with GDTSETUP and its E*nhanced Setup*.

C.4 Levels of Hierarchy Within the ICP Firmware

RAIDYNE® is based on four fundamental levels of hierarchy. Each level has its "own drives" (= components). The basic rule is:

To build up a "drive" on a given level of hierarchy, the "drives" of the next lower level of hierarchy are used as components.

Level 1:

Physical Drives = hard disks, removable hard disks, some MO drives [1] are located on the lowest level. This can be either devices with a SCSI interface, or devices with a Fibre Channel Arbitrated Loop (FCAL) port.
They are the basic components of all "drive constructions" you can set up. However, before they can be used by the firmware, these hard disks must be "prepared", a procedure we call *initialization*. During this initialization each hard disk receives information which allows a univocal identification even if the SCSI-ID, FCAL-ID or the controller is changed. For reasons of data coherency, this information is extremely important for any drive construction consisting of more than one physical drive.

Level 2:

On the next higher level are the **Logical Drives**. Logical Drives are introduced to obtain full independence of the physical coordinates of a physical device. This is necessary to easily change the whole ICP Controller and the channels, IDs, without loosing the data and the information on a specific disk array.

[1] Also see section C.5.

Level 3:
On this level of hierarchy, the firmware forms the **Array Drives**. This can be:

- Single Disks (one hard disk, some vendors call it JBOD – "Just A Bunch Of Drives")
- Chaining Sets (concatenation of several hard disks)
- RAID 0 Array Drives
- RAID 1 Array Drives, RAID 1 Array Drives plus hot fix drive
- RAID 4 Array Drives, RAID 4 Array Drives plus hot fix drive
- RAID 5 Array Drives, RAID 5 Array Drives plus hot fix drive
- RAID 10 Array Drives, RAID 10 Array Drives plus hot fix drive

Level 4:
On the highest level of hierarchy, the firmware forms the **Host Drives**. In the end, only these Host Drives can be accessed by the host operating system of the computer. Drives C, D, etc. under MS-DOS, Windows NT, NetWare, etc. are always referred to as Host Drives by the firmware. The firmware automatically transforms each newly installed Logical Drive and Array Drive into a Host Drive. This Host Drive is then assigned a Host Drive number which is identical to its Logical Drive or Array Drive number.
The firmware is capable of running several Host Drives of the most various kinds at the same time. An example for MS-DOS: drive C is a RAID 5 type Host Drive (consisting of 5 hard disks), drive D is a single hard disk, and drive E is a CDROM communicating with RAIDYNE® through corelSCSI and the ICP ASPI manager.
On this level the user may split an existing Array Drive into several Host Drives.
After a capacity expansion of a given Array Drive the added capacity appears as a new Host Drive on this level. It can be either used as a separate Host Drive, or merged with the first Host Drive of the Array Drive.

Within GDTSETUP, each level of hierarchy has its own special menu:

Level 1	⇨	Menu: ***Configure Physical Devices***
Level 2	⇨	Menu: ***Configure Logical Drives***
Level 3	⇨	Menu: ***Configure Array Drives***
Level 4	⇨	Menu: ***Configure Host Drives***

Generally, each installation procedure passes through these 4 menus, starting with level 1.

Therefore:

- First initialize the ***Physical Drives***.
- Then configure the ***Logical Drives***.
- Then configure the ***Array Drives*** (e.g. Array Drives with RAID 0, 1, 4, 5 and 10).
- Finally, configure the ***Host Drives***.

C.5 Using CDROMs, DATs, Tapes, etc.

A SCSI device that is not a SCSI hard disk or a removable hard disk, or that does not behave like one, is called a ***Not Direct Access Device***.
Such a device is **not configured with GDTSETUP and does not form a Logical or Host Drive**. SCSI devices of this kind are either operated through the ASPI interface (Advanced SCSI programming Interface) (MS-DOS, Windows, Novell NetWare or OS/2), or are directly accessed from the operating system (UNIX, Windows NT). For more information on how to

use these devices, please refer to the corresponding chapters of this manual. Note: hard disks and removable hard disks are called ***Direct Access Devices***. However, there are some *Not Direct Access Devices*, for instance certain MO drives, which can be operated just like removable hard disks if they have been appropriately configured before (for example by changing their jumper setting).

But enough on the dry theory. Now here are the examples which explain step by step all the necessary basics for setting up Host Drives with your ICP Controller

C.6 Example 1 - Installing a Single Hard Disk

We presume that the controller and the hard disks have been installed properly.

Step 1: Loading GDTSETUP

You can load GDTSETUP in two ways:

1. Press the <CTRL><G> key combination when the ICP BIOS message comes up (shortly after switching on the computer) and load GDTSETUP from the Flash-RAM of the ICP Controller. In this case no operating system is required.
   If GDTSETUP was loaded this way, there is an "R" (ROM) behind the version number.

2. Load GDTSETUP from disk under MS-DOS. Boot the MS-DOS-operating system (either from a boot-floppy or from an already existing boot drive, i.e., IDE-hard disk etc.). In order for GDTSETUP to work properly, you have to load the device driver GDTX000 first. This can be done in two ways:

   a.) Load GDTX000 from the DOS-command level by typing in GDTX000<ENTER>
   b.) Load GDTX000 automatically through the CONFIG.SYS file (DEVICE=GDTX000.EXE)

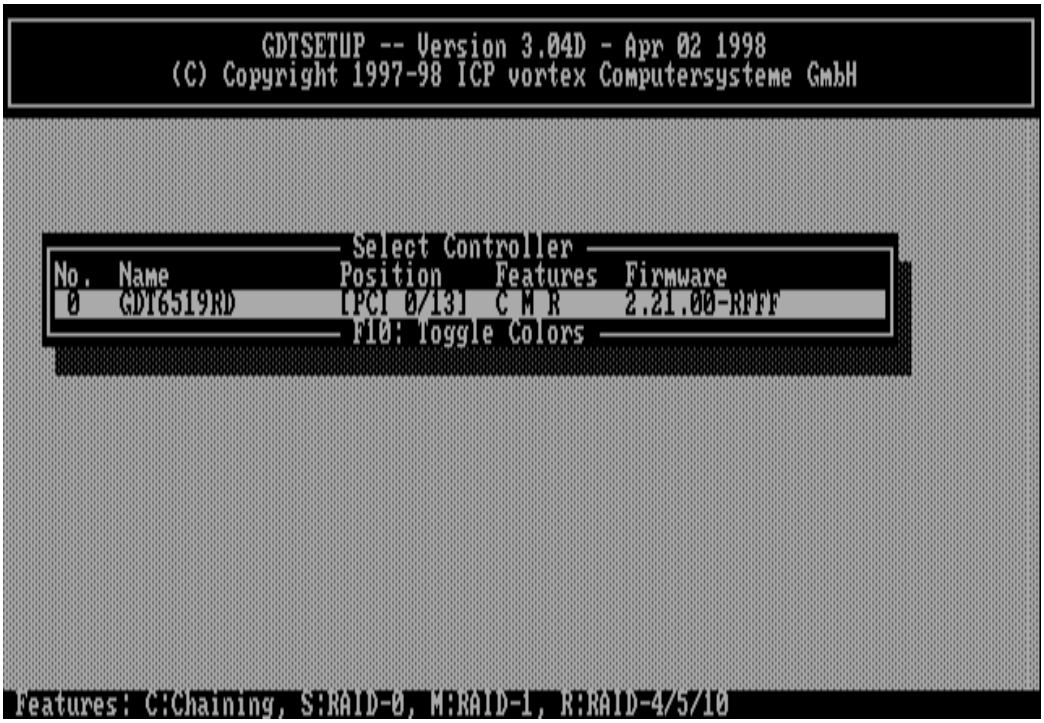
   Note: GDTSETUP.EXE as well as GDTX000.EXE are on the *System Disk* - DOS.

   If GDTSETUP was loaded this way, there is a "D" (Disk) behind the version number.

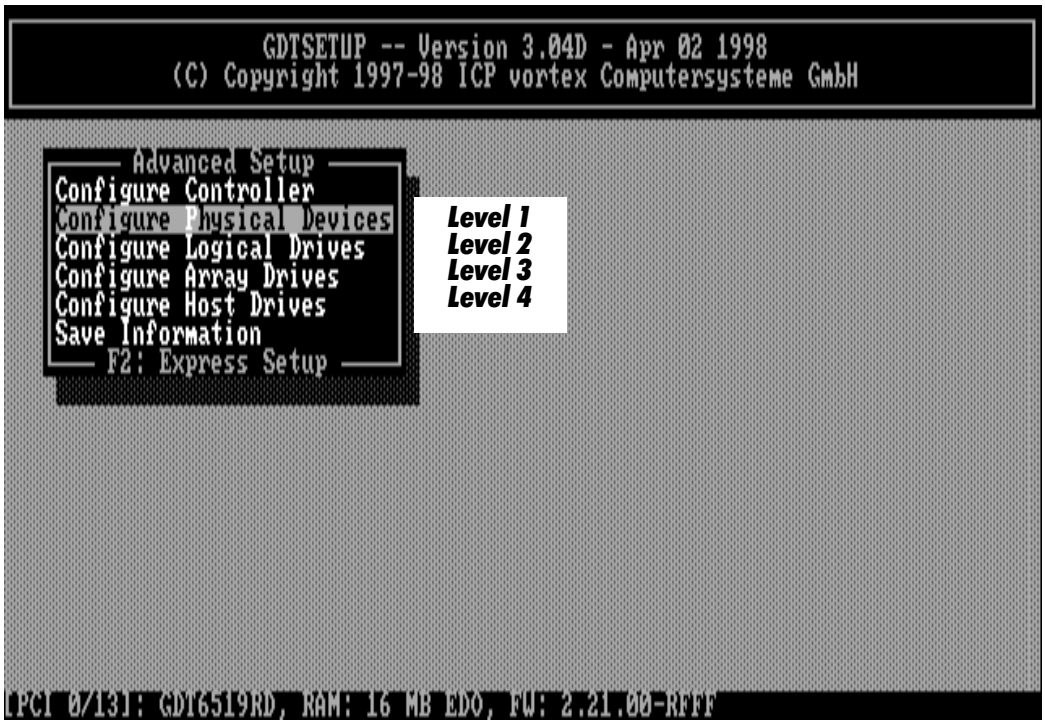
You may now ask what are the differences between the two GDTSETUP variants ?
They are small. The GDTSETUP variant loadable from disk under MS-DOS also additionally allows the partitioning of Host Drives, which is not possible with GDTSETUP loaded from the Flash-RAM. Loading GDTSETUP from the Flash-RAM is pretty easy, since there is nothing more required to configure the disk arrays. User's, who have for instance, an NT installation without a DOS partition, will highly appreciate this Flash-RAM-resident GDTSETUP.

For our example, it is not relevant whether we load GDTSETUP from the Flash-RAM, or from disk.

Now load GDTSETUP. The first menu asks you to select the desired ICP Controller. In our example, there is only one ICP Controller installed in the system. Therefore, simply press <ENTER> and then <F2> to select the Advanced Setup.



The main menu gives you the following options. As mentioned before, we have to go through levels 1 to 4 to install the hard disk (with almost nothing to do on levels 3 and 4).



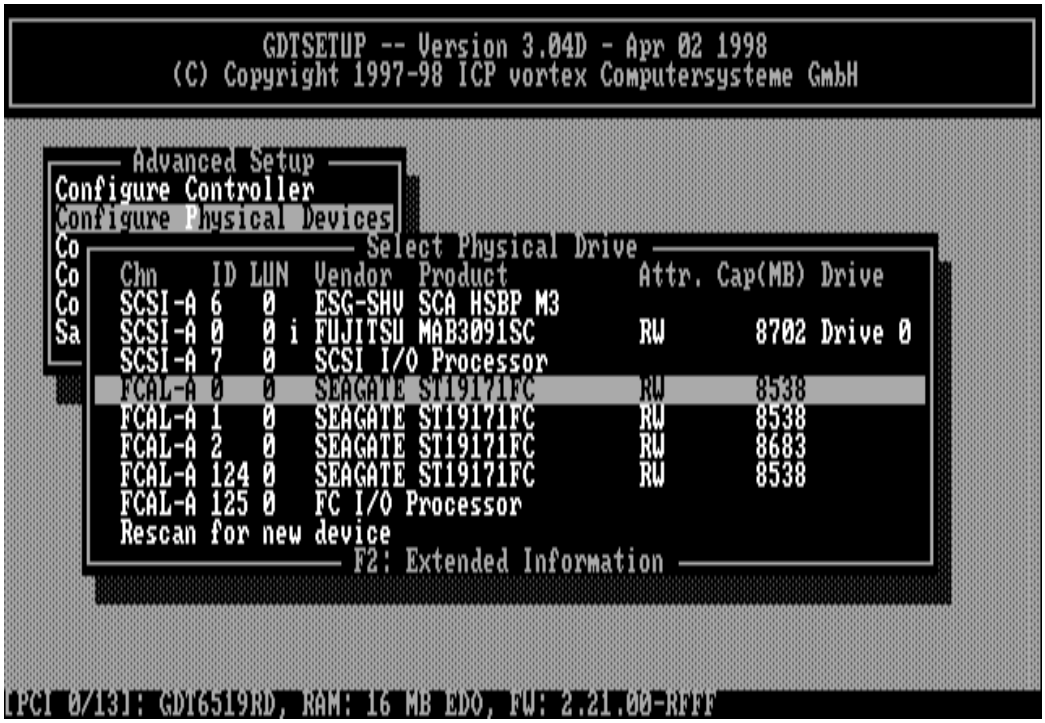
Step 2: Configure Physical Devices

Now activate the menu *Configure Physical Devices* (level 1). A list appears showing all hard disks found on the ICP Controller's I/O channels. If you have an ICP Controller with a different number of I/O channels, the existing channels are displayed. Note: This screen will always report all devices that are found, even though GDTSETUP only allows you to work on *Direct Access Devices* (and therefore not on tape drives, DATs, CD ROMs etc.).

The screen shows you:

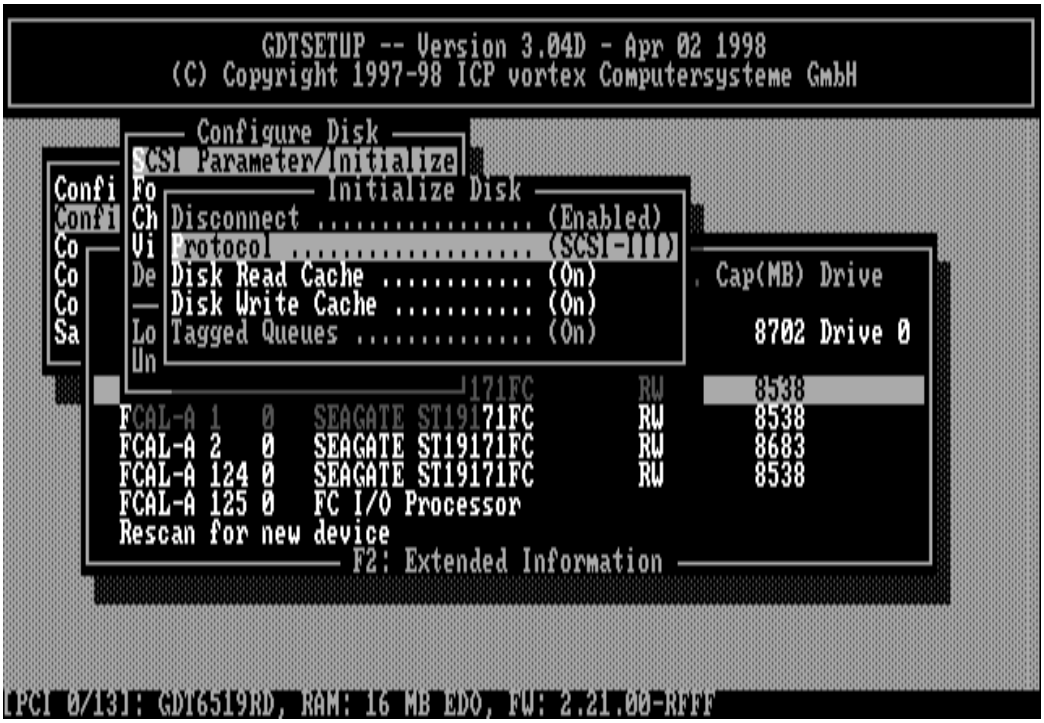
- the I/O channel to which a device is connected (this can be a SCSI or a FCAL channel)
- which ID the drive has (the entry I/O Processor stands for the corresponding I/O channel of the ICP Controller. It has the default ID setting 7 for SCSI and 125 for FCAL).
  The IDs of the FCAL drives are normally assigned through the backplane of the Fibre Channel Enclosure.
- the initialization status
- the names of the drives
- the Read-Write-Status. [RW] = Read + Write
- the gross capacity
- membership in a Logical, Array or Host Drive

Use the cursor keys ↑ and ↓ to select the drive you wish to initialize. We take the first drive of FCAL-A in the list. With this drive selected, press <ENTER>.



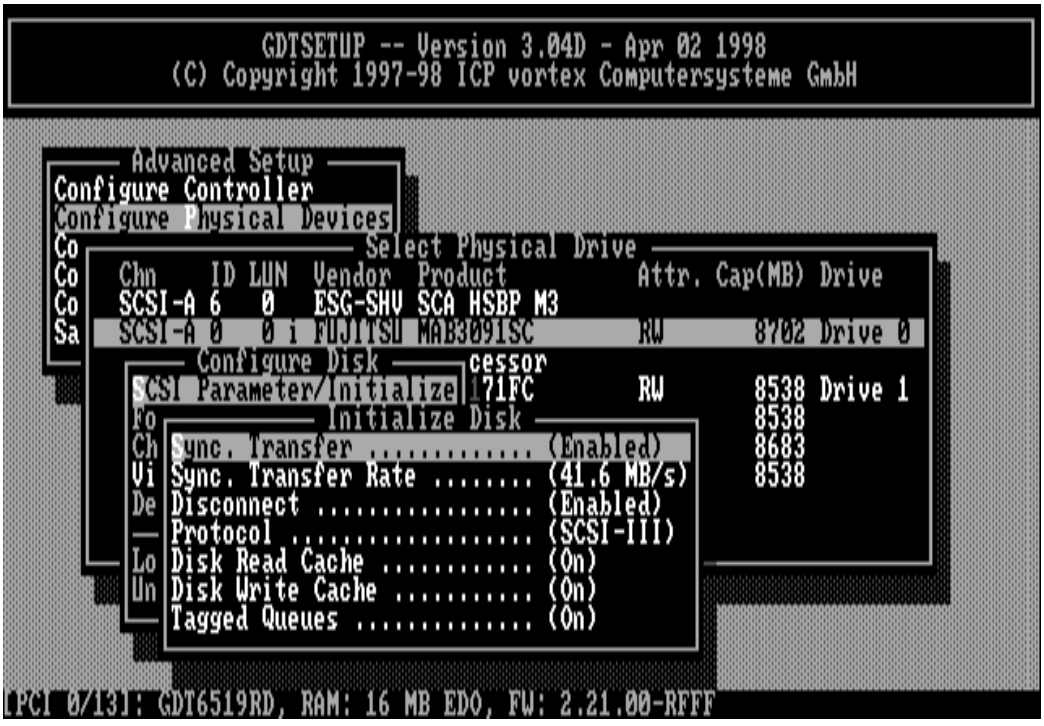
(Note: On SCSI-A, ID 0 and ID 6 are devices which are not relevant for our examples).

The *Configure Disk* menu appears which shows various options.
For our example we choose the SCSI *Parameter/Initialize* menu option and press <ENTER>.
The parameters within this menu can be changed by pressing <ENTER> and selecting the new setting.



With Fibre Channel devices, there are only view settings which are relevant. They should be "On" or "Enabled". (Note: Fibre Channel devices are also controlled by the SCSI protocol.)

With "real" SCSI devices, there are more parameters to describe the device.



1. *Sync. Transfer*: *Enable*
The SCSI-bus allows an asynchronous and a synchronous transfer. Every SCSI device must be able to perform the first type of transfer, the second one is optional. The advantage of the synchronous transfer lies in a higher data transfer rate as the signal transfer times on the possibly long SCSI-cable have no influence on the transfer rate anymore. Two SCSI-bus

participants wanting to exchange data between each other have to check if and how (i.e., with which parameters) a synchronous data transfer between them is possible. Therefore, the mere setting does not automatically enable synchronous data transfer; this mode is only effective if both devices support it and after they have checked their capability of communicating with each other in this mode.

2. *Sync. Transfer Rate*
The maximum synchronous transfer rate can be limited. This limitation may become necessary if a particular SCSI cabling does not allow the maximum rate the drive and the controller could achieve. In our example, we leave the rate at 20.0 MB/s (for Wide SCSI at 20.0 MB/s and Wide & Ultra SCSI at 40.0 MB/s).
Note: In order to select a transfer rate above 10.0 MB/s the Protocol has to be set to SCSI-III.

3. *Disconnect*: *Enable*
The concept of the SCSI-bus allows several participants (8 IDs with 8 LUNs each). All these participants should be able to use the bus in a manner that causes the least reciprocal disturbance or obstruction. A participant should therefore vacate the bus if he does not need it. For reasons of performance, it is particularly important to guarantee a high degree of overlapping of the actions on the SCSI-bus. This high degree of overlapping can be achieved if a SCSI device is allowed to disconnect, thus leaving the bus to be used by other participants. If there is only one SCSI device connected to the SCSI-bus, Disconnect should be disabled.

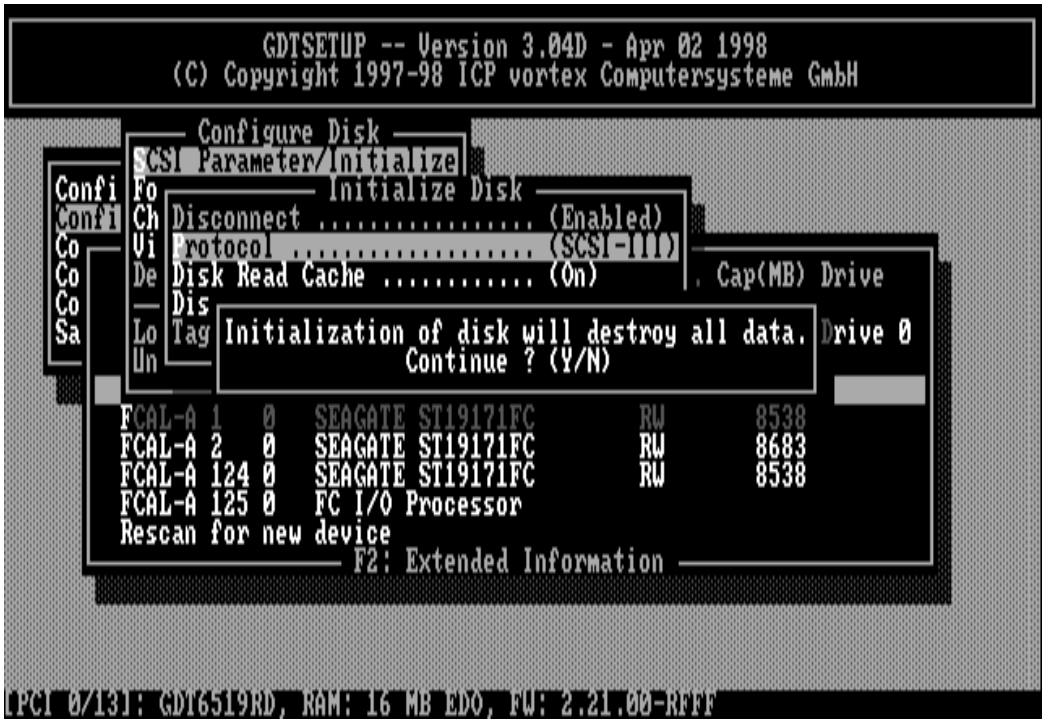
4. *Protocol*
This can be either SCSI-II or SCSI-III.
If you select SCSI-III make sure, that your hard disk supports this protocol. Most new multi-GB hard disks support SCSI-III. To enable Ultra (FAST-20) transfer rates (Narrow: 20 MB/s; Wide: 40 MB/s) SCSI-III protocol is required.

5. *Disk Read Cache / Disk Write Cache / Tagged Queues*
If a drive supports particular SCSI features you enable them (On).
Note: Most of the modern drives support disk caching (read and write). Some do not support Tagged Queues.

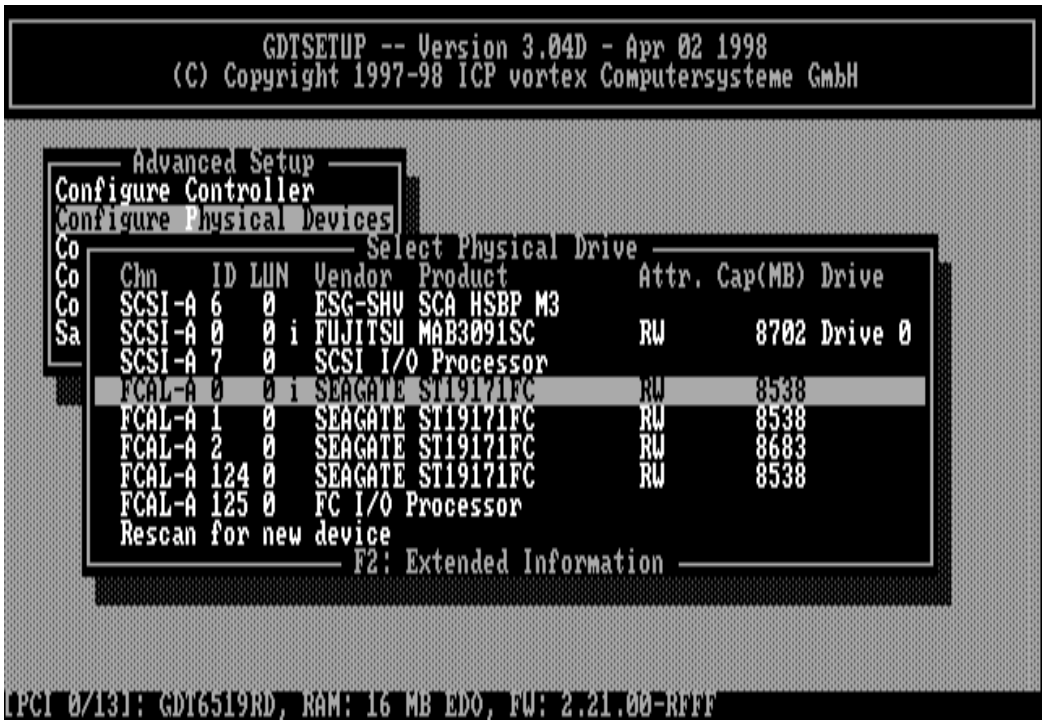
Press <ESC> to leave the SCSI P*arameter*/I*nitialize* menu.
GDTSETUP displays a warning on the destruction of all data. This implies two different evaluations, according to the drive's current state and the options you have selected:

1. F*irst* I*nitialization of the device*.
   In this case the warning must be taken seriously. If the drive was previously connected to a different controller (e.g., NCR etc.) and still contains data, this data will be lost now.

2. T*he device was already initialized*.
   If only internal parameters, such as Disconnect, Synchronous Transfer and SCSI-II options have been changed, the data on the drive remains intact. Only the function state of the device is changed.



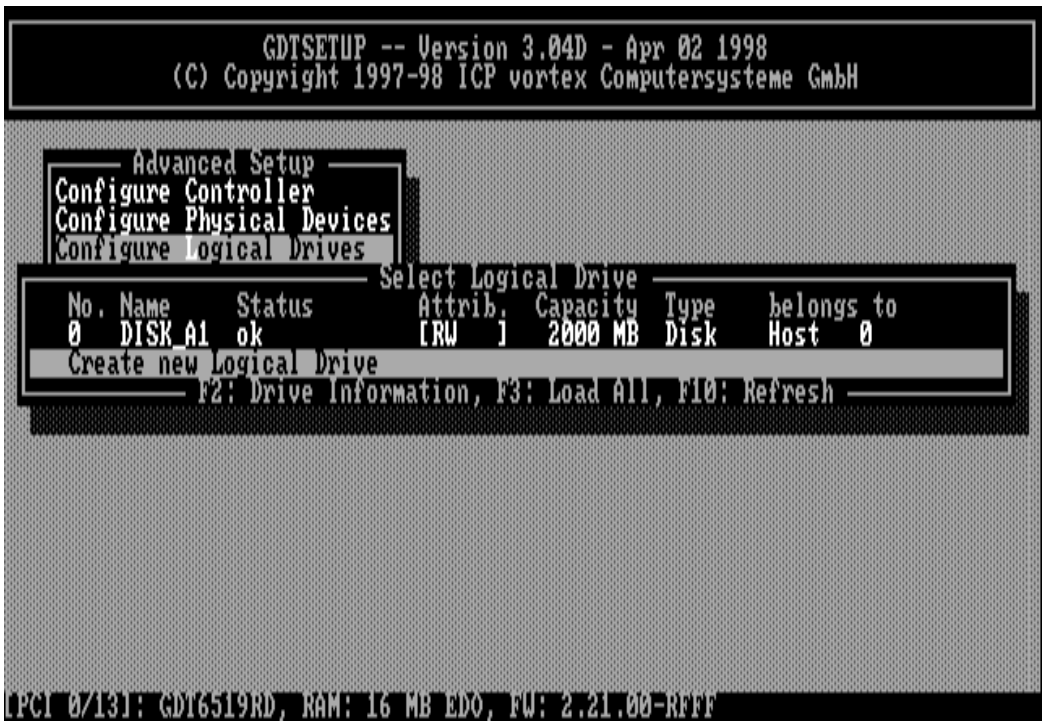
Press <Y> and we are back on the main screen of level 1 and see that the initialization-status of the device has changed.



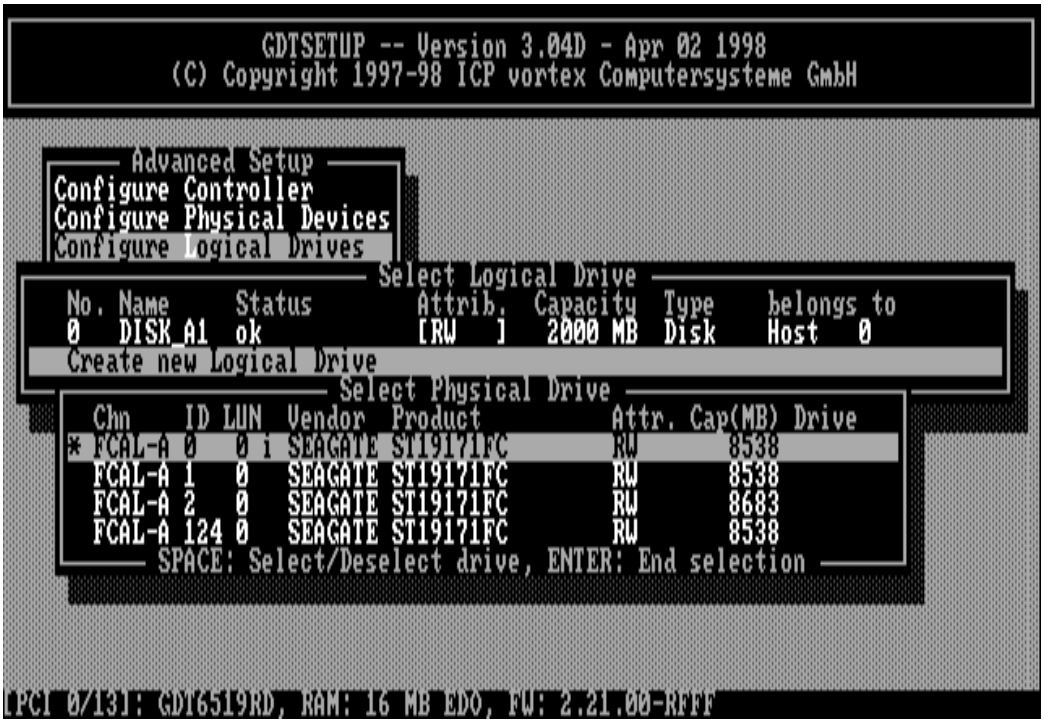
Step 3: Configure Logical Drives

We now leave level 1 (by pressing the <ESC>-key) and are back in the main menu. Now, with the cursor keys ↑ and ↓ select *Configure Logical Drives* and go to level 2 by pressing <ENTER>.

The main screen of level 2 appears. Move the selection bar to C*reate new* L*ogical* D*rive* and press <ENTER> .



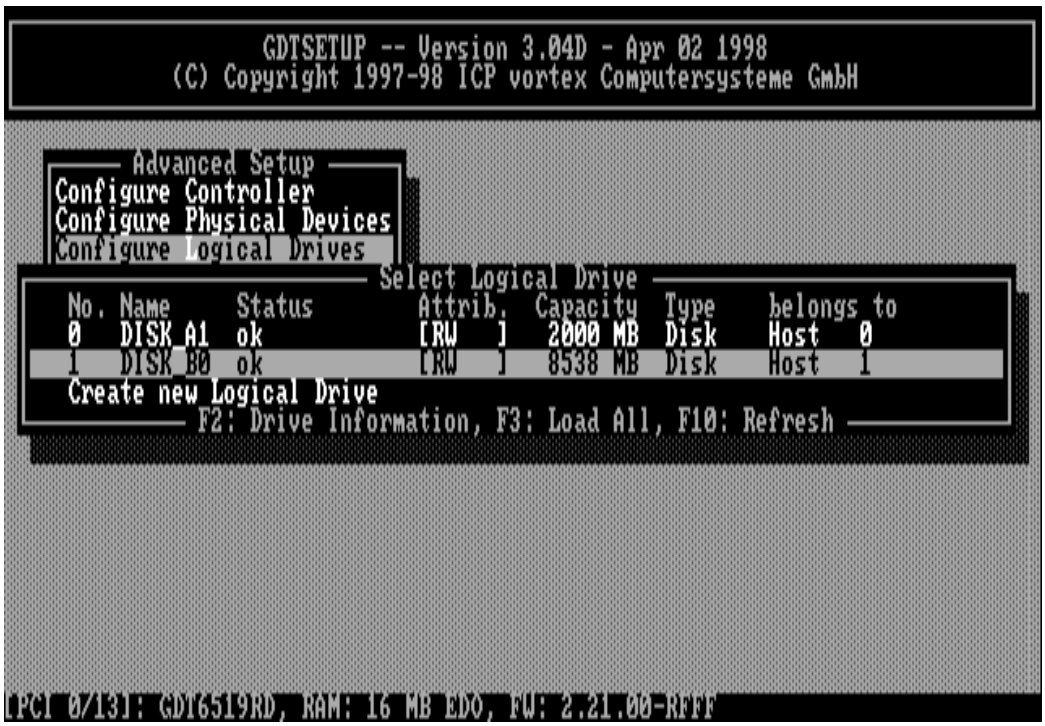
Note: The already existing Logical Drive in this list has no relevance for our example.



Select the initialized hard disk with the <SPACE>-bar (it becomes marked with an "*") and press <ENTER>.

For security reasons, you will be asked again if you want to use the selected disk to create a Logical Drive.
As we are sure of our choice, we confirm with <Yes>. GDTSETUP allows you to limit the hard disk size for this Logical Drive. This becomes interesting when you configure disk arrays. For this example we use the full capacity and press <ENTER> .

The dialog box is closed and we are back in the main menu of level 2.



As you can see, we have already created a new Logical Drive of the type *Disk*. The name of the Logical Drive is assigned automatically and contains the channel description and the I/O channel ID after the "_" . This can serve as a reminder when you install a complex system with many drives. (Naturally, you may change the name.)
This concludes the installation on level 2. Now press the <ESC>-key to leave this screen.

Since we have only a single disk assigned to a Logical Drive, there is nothing to do in the *Configure Array Drives* menu, thus we go directly to the *Configure Host Drives* menu and have ***no Step* 4.**

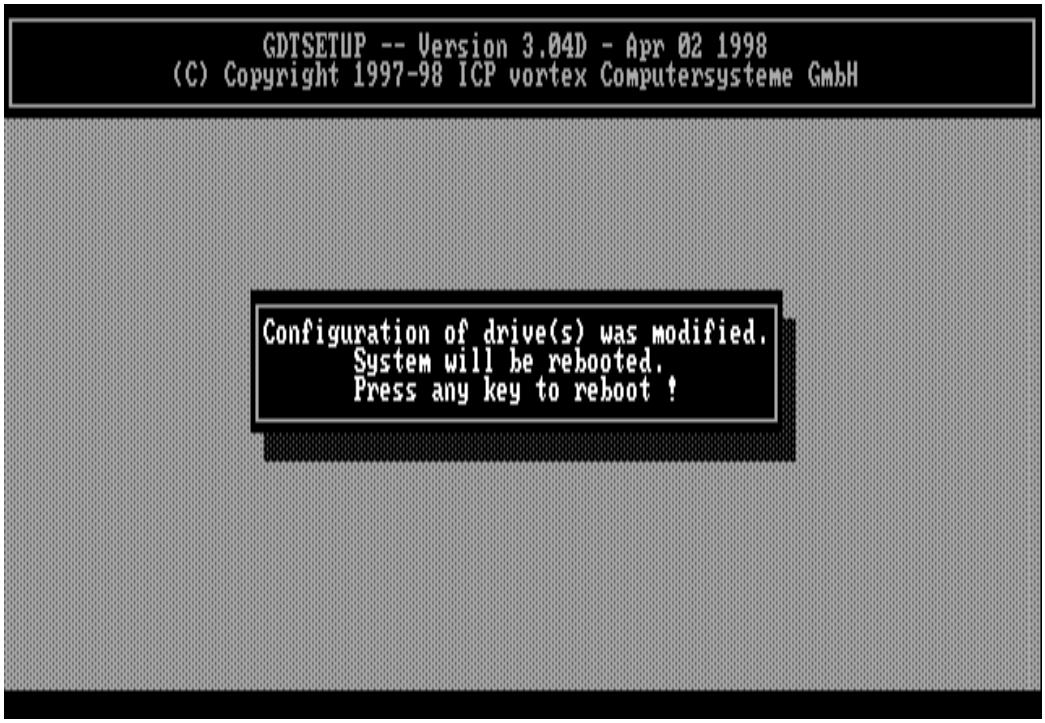
Step 5: Configure Host Drives

We are now back in the main menu of GDTSETUP and select *Configure Host Drive*.
The main screen of level 4 appears. Press <ENTER> . A list of available Host Drives is displayed. Again, the first entry is not relevant for our example.
At the second position we find our previously configured Logical Drive. It was automatically transformed into a Host Drive, thus for this example we have nothing to do in this menu.
Press <ENTER> to get a list of possible menu options.

We should not forget to mention, that if you would have selected *Create new Host Drive*, this would have lead you to the same menu as the Express Setup mode.
But this example is an exercise which should help you to gain a better understanding of how the ICP Controller and GDTSETUP work. So don't believe we let you do redundant homework.
By the way, if you have loaded GDTSETUP from the Flash-RAM (<CTRL><G>) the *Partition Drive* option will be missing in this menu. The reason is that partitioning makes no sense when there is not an operating system loaded and the INT13H extension of the ICP Controller has not yet been activated.

Step 6: Leaving GDTSETUP

We are now back in the main menu of GDTSETUP. The installation is completed, and we therefore leave GDTSETUP by pressing the <ESC>-key. The following message appears:



As we are done with the installation and therefore definitely want to leave GDTSETUP, we press any key.

IMPORTANT: Always end GDTSETUP by leaving the program in the regular way (do not warm-boot with CTRL-ALT-DEL or cold boot by pressing the RESET button). Certain information is only transferred to the controller when you leave GDTSETUP in the regular way.

The Host Drive we have configured in this example is now ready for the installation of the desired operating system.

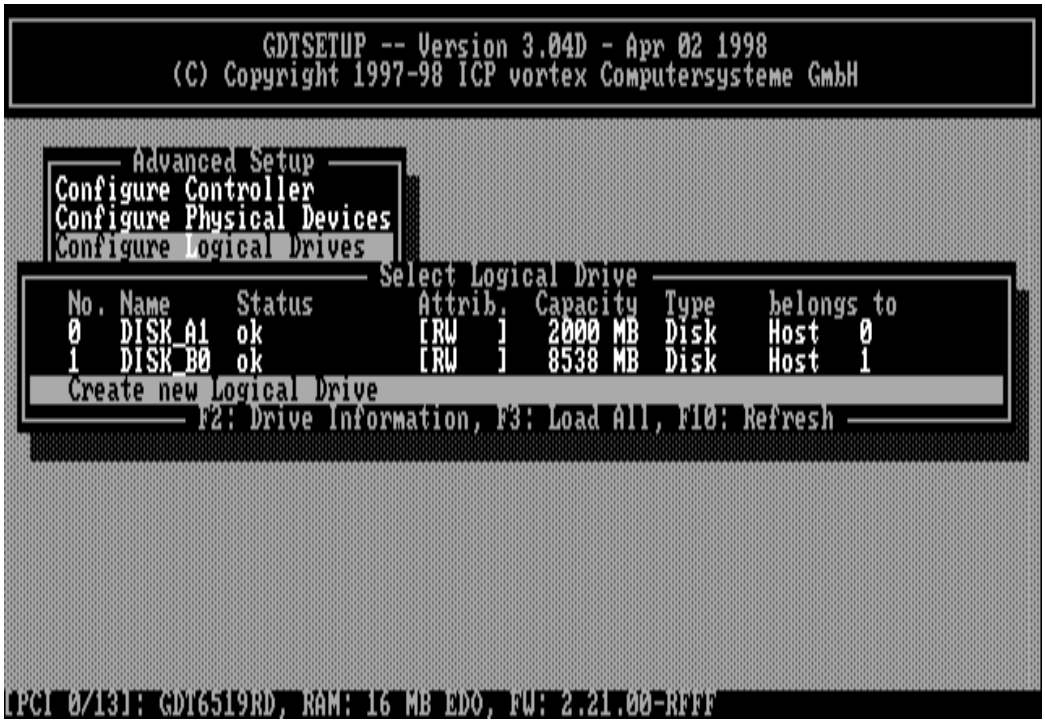
C.7 Example 2 - Installing a Mirroring Array - RAID 1

It is our intention to install a Mirroring Array consisting of two identical hard disks. In the classical terminology of the RAID levels this is called a RAID 1 disk array.
We presume that the controller and the hard disks have been properly installed. **Step 1** of the installation is the same as in the first example, therefore we do not explain it again.
Step 2 regards the initialization of the second device. Proceed as described in the first example.

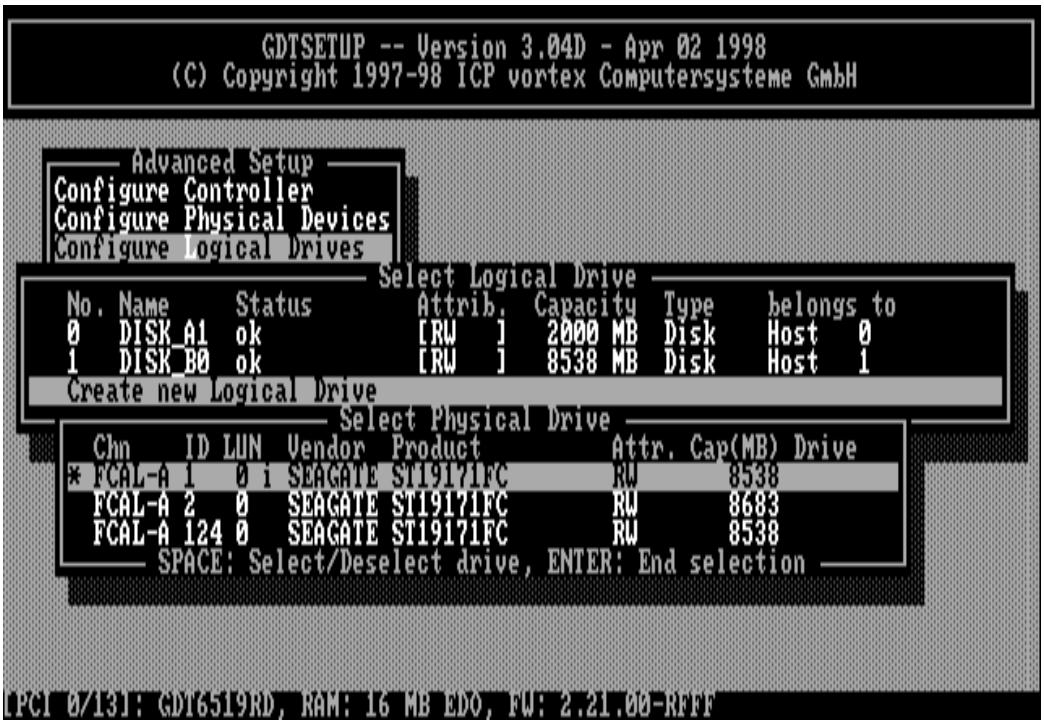
Step 3: Configure Logical Drives

We now leave level 1 (by pressing the <ESC>-key) and are back in the main menu. Now, with the cursor keys ↑ and ↓ select C*onfigure* L*ogical* D*rives* and go to level 2 by pressing <ENTER>.

The main screen of level 2 appears. Move the selection bar to C*reate new* L*ogical* D*rive* and press <ENTER> .

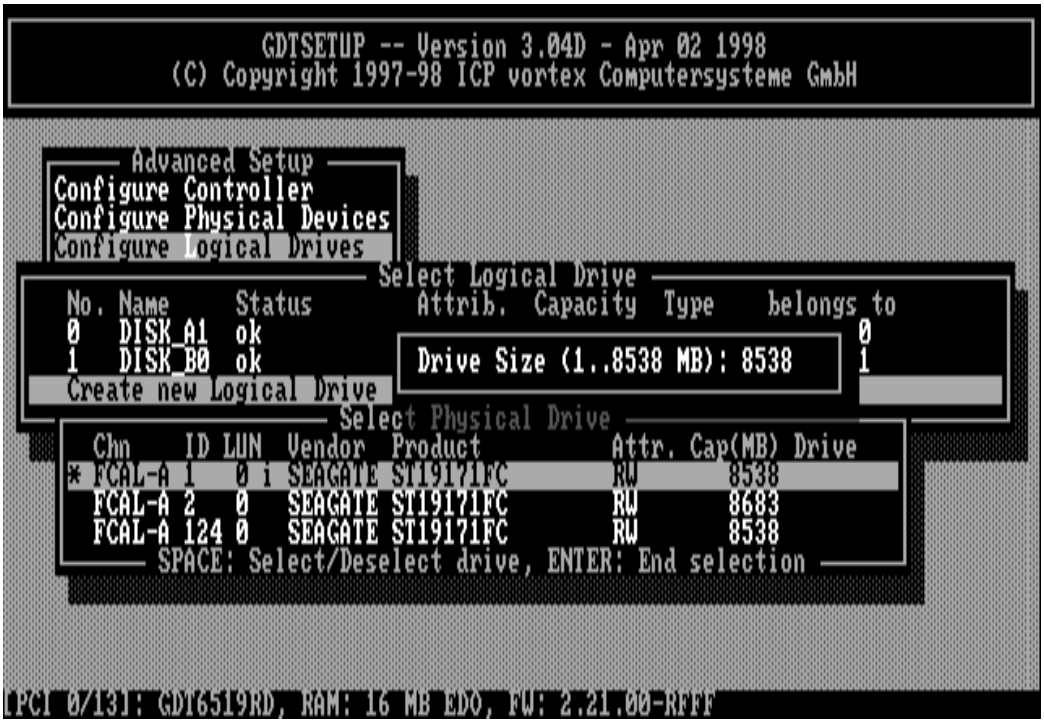


Note: The already existing Logical Drive in the first position of this list has no relevance for our example. The second entry was created before in Example 1.

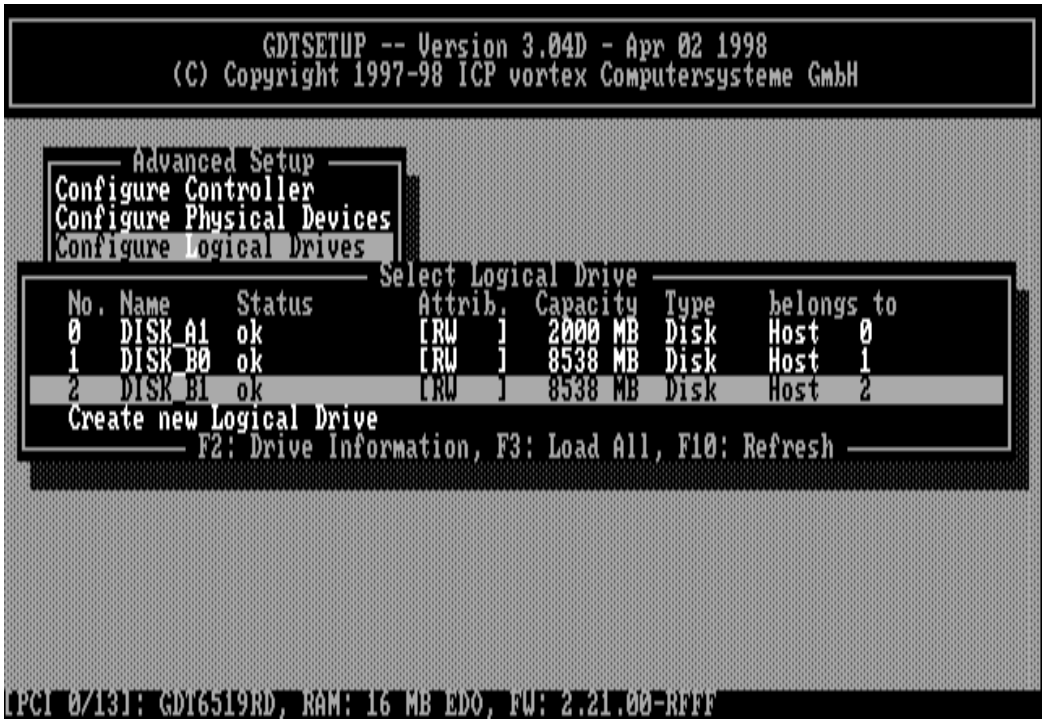


Select the initialized hard disk with the <SPACE>-bar (it becomes marked with an "*") and press <ENTER>.

For security reasons, you will be asked again if you want to use the selected disk to create a Logical Drive.
As we are sure of our choice, we confirm with <Yes>. GDTSETUP allows you to limit the hard disk size for this Logical Drive. This becomes interesting when you configure disk arrays. For this example we use the full capacity and press <ENTER> .



The dialog box is closed and we are back in the main menu of level 2.

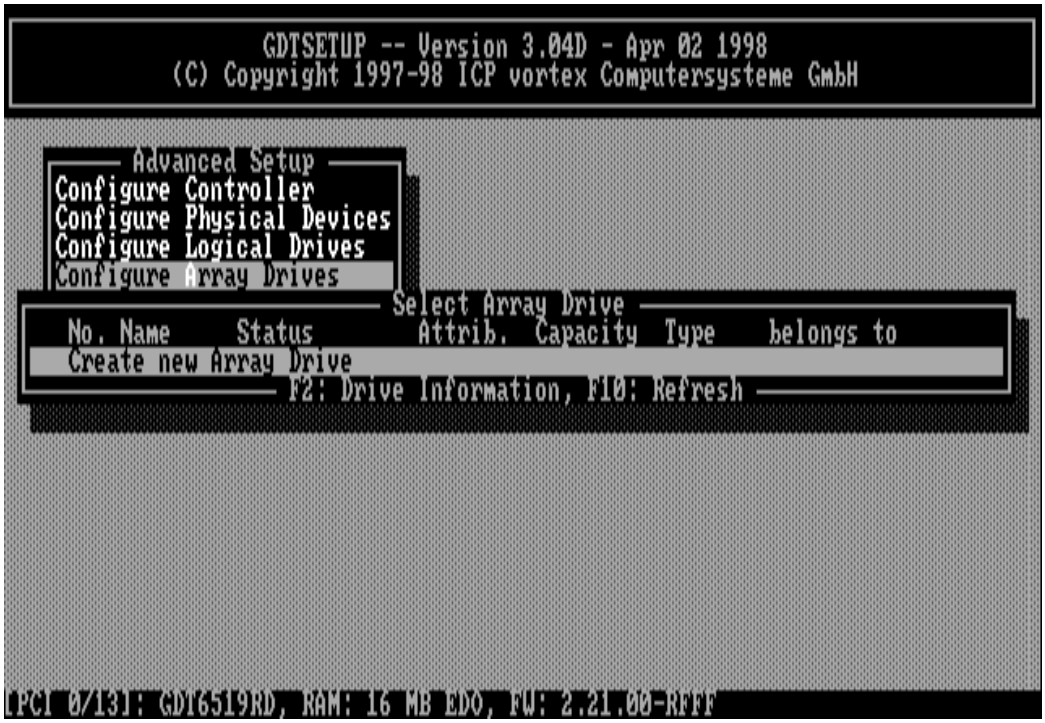


As you can see, we have created another Logical Drive of the type D*isk*. The name of the Logical Drive is assigned automatically and contains the channel description and the I/O channel ID after the "_" . This can serve as a reminder when you install a complex system with many drives. (Naturally, you may change the name.)
This concludes the installation on level 2. Now press the <ESC>-key to leave this screen.

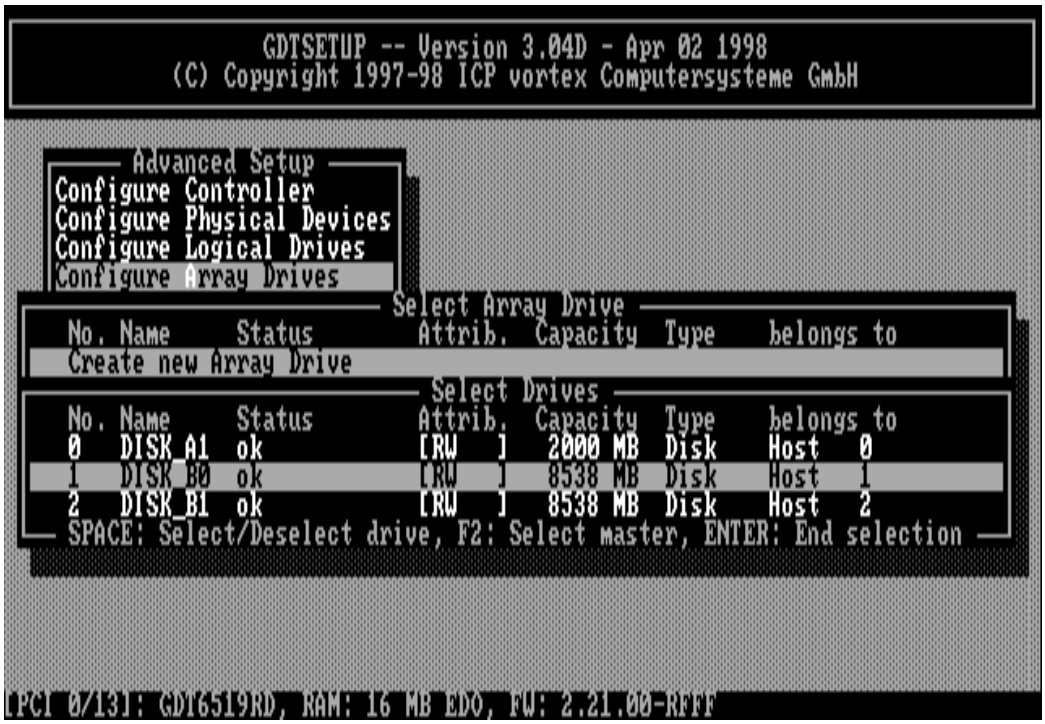
In the next step it is our objective to add the third Logical Drive in this list as a mirroring partner to the second Logical Drive of the list, thus configuring a RAID 1 disk array.

Step 4: Configure Array Drives

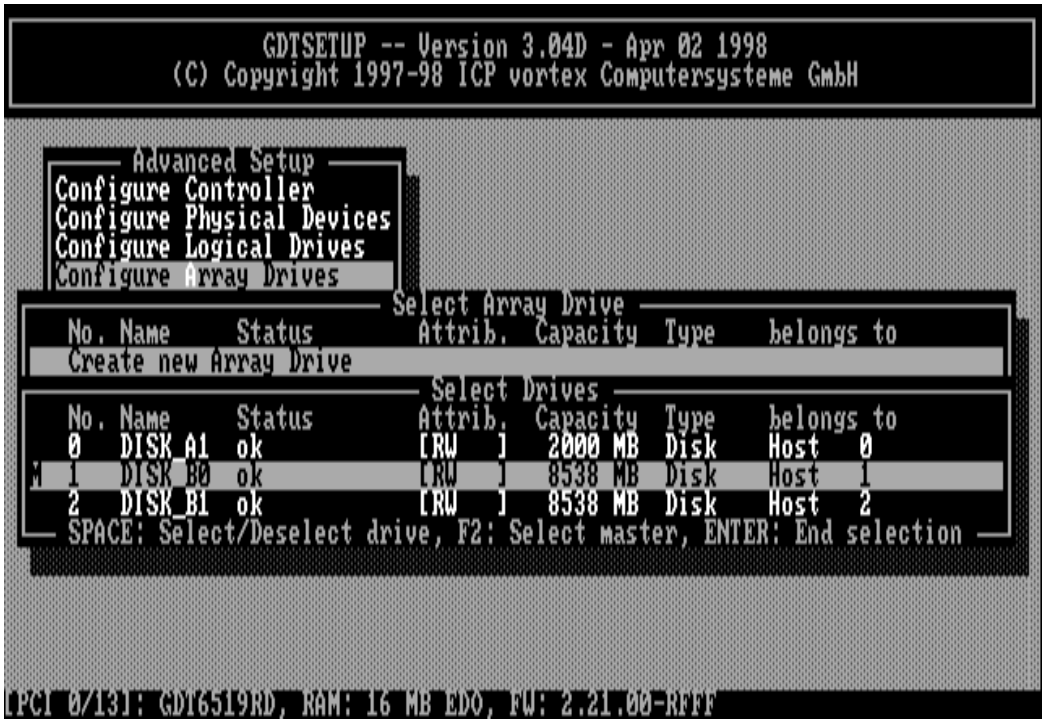
We now leave level 2 (by pressing the <ESC>-key) and are back in the main menu. Now, with the cursor keys ↑ and ↓ select C*onfigure* A*rray* D*rives* and go to level 3 by pressing <ENTER>.



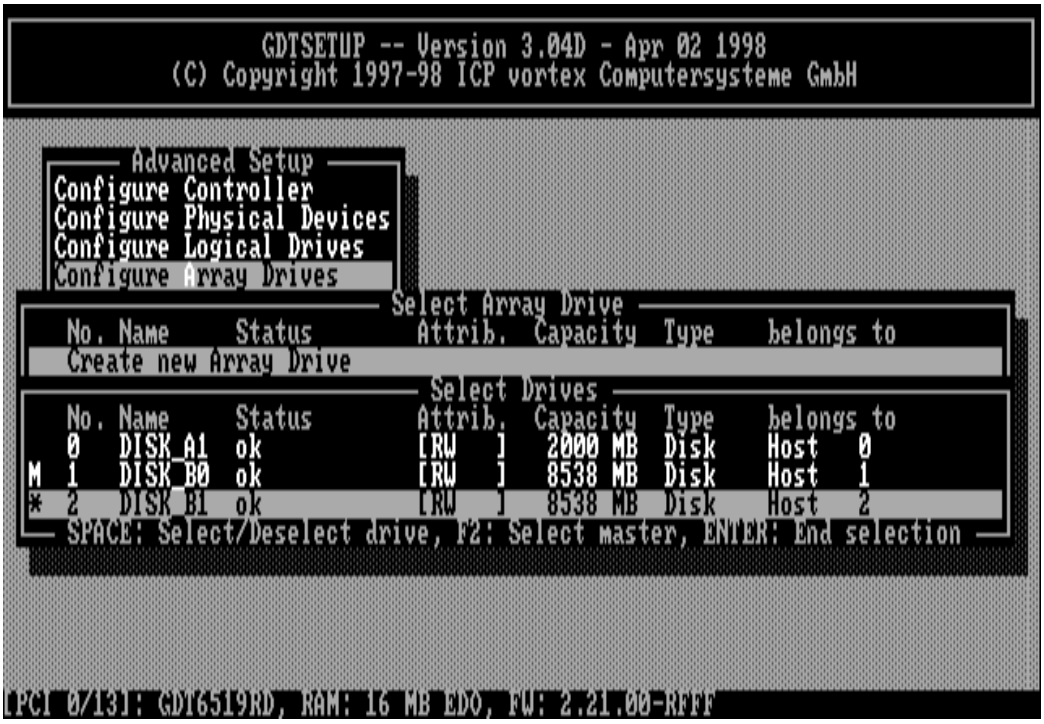
Since we want to create a new Array Drive press <ENTER>.
Note: The first entry in the following list has no relevance for our example.



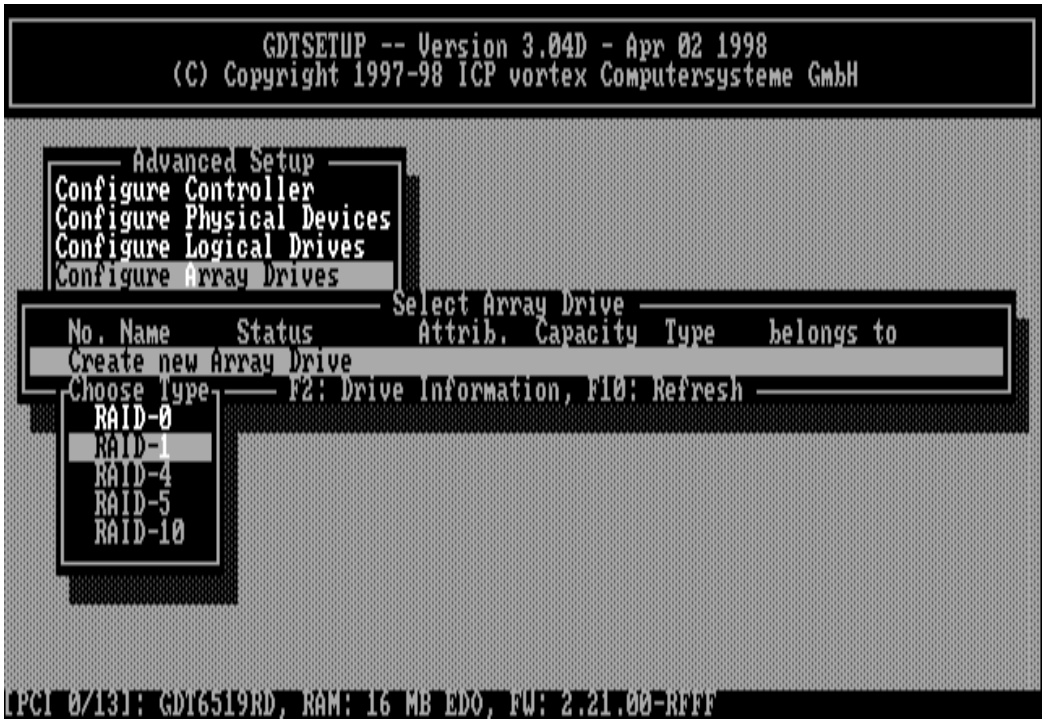
Move the selection bar to the second entry and press the <SPACE>-bar. The entry is marked with an "M" for Master. This means that the data from this Logical Drive are copied to the second Logical Drive, which we will select next.



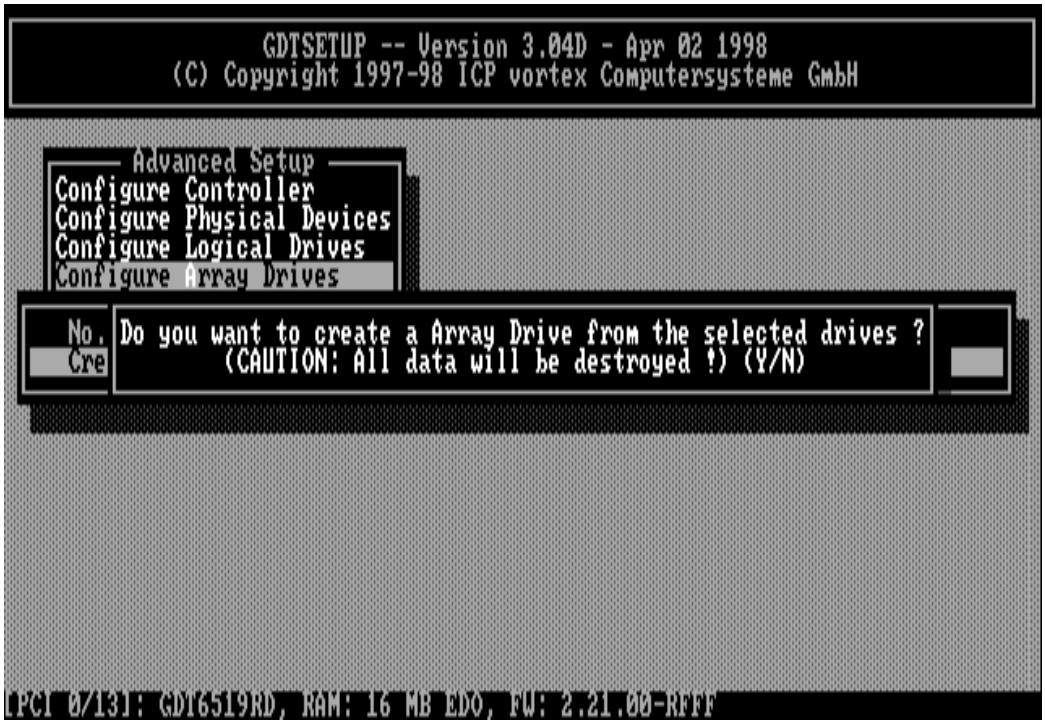
Move the selection bar with the cursor key ↓ to the next entry and press the <SPACE>-bar, again. It is marked with an "*"(pressing the <SPACE>-bar again undoes your choice).



When the Logical Drive is selected, confirm with <ENTER>. GDTSETUP displays now a list of possible RAID levels, available with the number of Logical Drives selected. In our case it is RAID 0 (data striping) and RAID 1. Move the selection bar to RAID-1 and press <ENTER>.



GDTSETUP displays a security request, which we answer with <Y>.



As you can easily recognize, we have created a new Array Drive of the Type RAID-1. Its state is build. When we leave GDTSETUP at the end of this example, you will see that the ICP Controller automatically copies the data of the first Logical Drive (our master) to the second Logical Drive. During this s*ynchronization* the RAID-1 array is fully operational.
The functioning of a RAID-1, or mirroring, disk array, is easy to understand: On the ICP Controller, one write-access from the host computer is transformed into two write-accesses (to both Logical Drives forming the mirroring array). If the two Logical Drives are built of hard disks, which are connected with different I/O channels of the ICP Controller, both write-

accesses are performed simultaneously (this method is often called *Disk Duplexing*). During a read-access of the host computer the data will be read from the Logical Drive whose hard disk has the fastest access to the data requested.
If a hard disk should fail (for instance due to a mechanical defect), all data is still available on the other Logical Drive. In this event, the controller gives an acoustical alarm.

Steps 5 and 6 are the same as in example 1.

C.8 Example 3 - Installing a RAID 5 Disk Array

We presume that the controller and the hard disks have been installed properly.

Step 1: Loading GDTSETUP

You can load GDTSETUP in two ways:

1. Press the <CTRL><G> key combination when the ICP BIOS message comes up (shortly after switching on the computer) and load GDTSETUP from the Flash-RAM of the ICP Controller. In this case no operating system is required.
   If GDTSETUP was loaded this way, there is an "R" (ROM) behind the version number.

2. Load GDTSETUP from disk under MS-DOS. Boot the MS-DOS-operating system (either from a boot-floppy or from an already existing boot drive, i.e., IDE-hard disk etc.). In order for GDTSETUP to work properly, you have to load the device driver GDTX000 first. This can be done in two ways:

   a.) Load GDTX000 from the DOS-command level by typing in GDTX000<ENTER>
   b.) Load GDTX000 automatically through the CONFIG.SYS file (DEVICE=GDTX000.EXE)

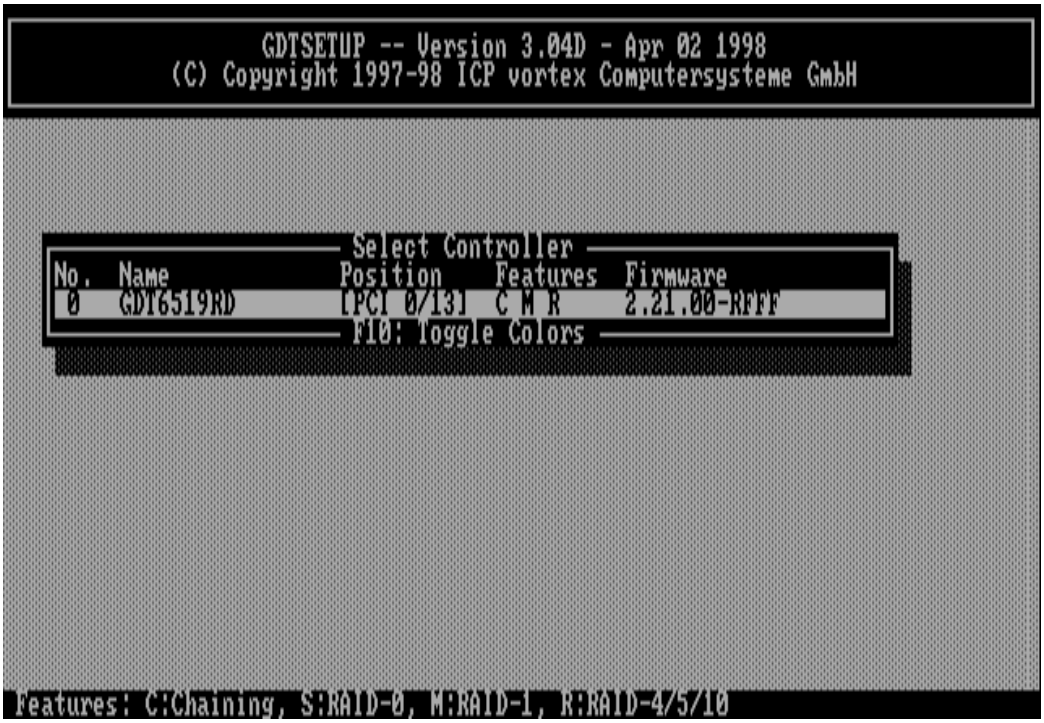
   Note: GDTSETUP.EXE as well as GDTX000.EXE are on the *System Disk* - DOS.
   If GDTSETUP was loaded this way, there is a "D" (Disk) behind the version number.

You may now ask what are the differences between the two GDTSETUP variants ?

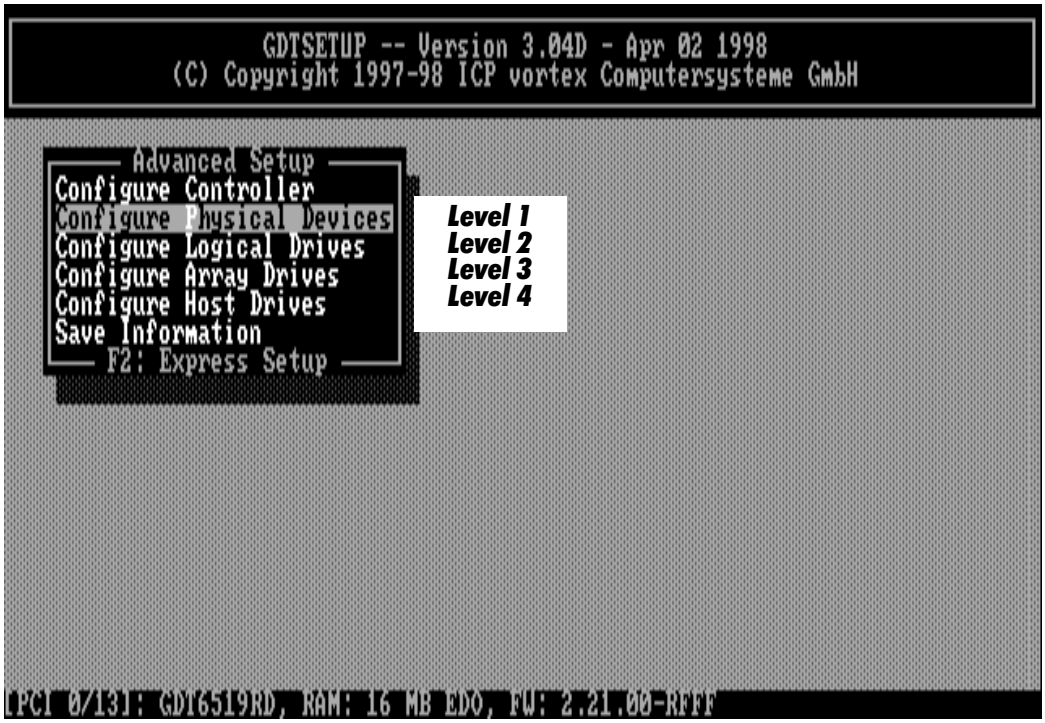
They are small. The GDTSETUP variant loadable from disk under MS-DOS also additionally allows the partitioning of Host Drives, which is not possible with GDTSETUP loaded from the Flash-RAM. Loading GDTSETUP from the Flash-RAM is pretty easy, since there is nothing more required to configure the disk arrays. User's, who have for instance, an NT installation without a DOS partition, will highly appreciate this Flash-RAM-resident GDTSETUP.

For our example, it is not relevant whether we load GDTSETUP from the Flash-RAM, or from disk.

Now load GDTSETUP. The first menu asks you to select the desired ICP Controller. In our example, there is only one ICP Controller installed in the system. Therefore, simply press <ENTER> and then <F2> to select the Advanced Setup.



The main menu gives you the following options. As mentioned before, we have to go through levels 1 to 4.



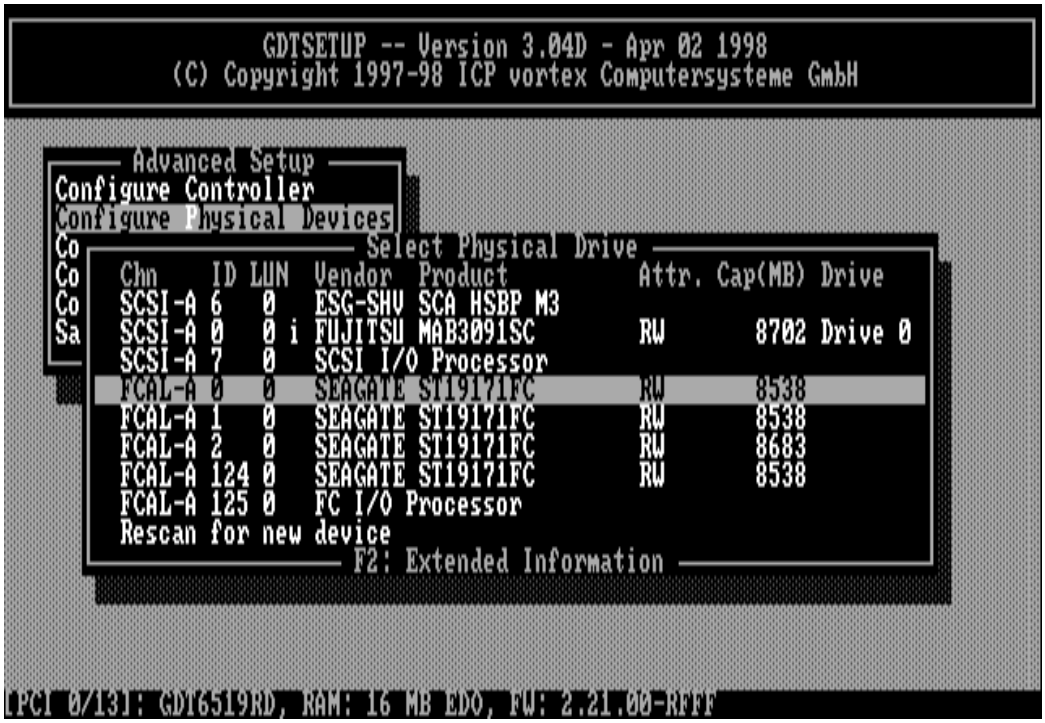
Step 2: Configure Physical Devices

Now activate the menu *Configure Physical Devices* (level 1). A list appears showing all hard disks found on the ICP Controller's I/O channels. If you have an ICP Controller with a different number of I/O channels, the existing channels are displayed. Note: This screen will always report all devices that are found, even though GDTSETUP only allows you to work on *Direct Access Devices* (and therefore not on tape drives, DATs, CD ROMs etc.).

The screen shows you:

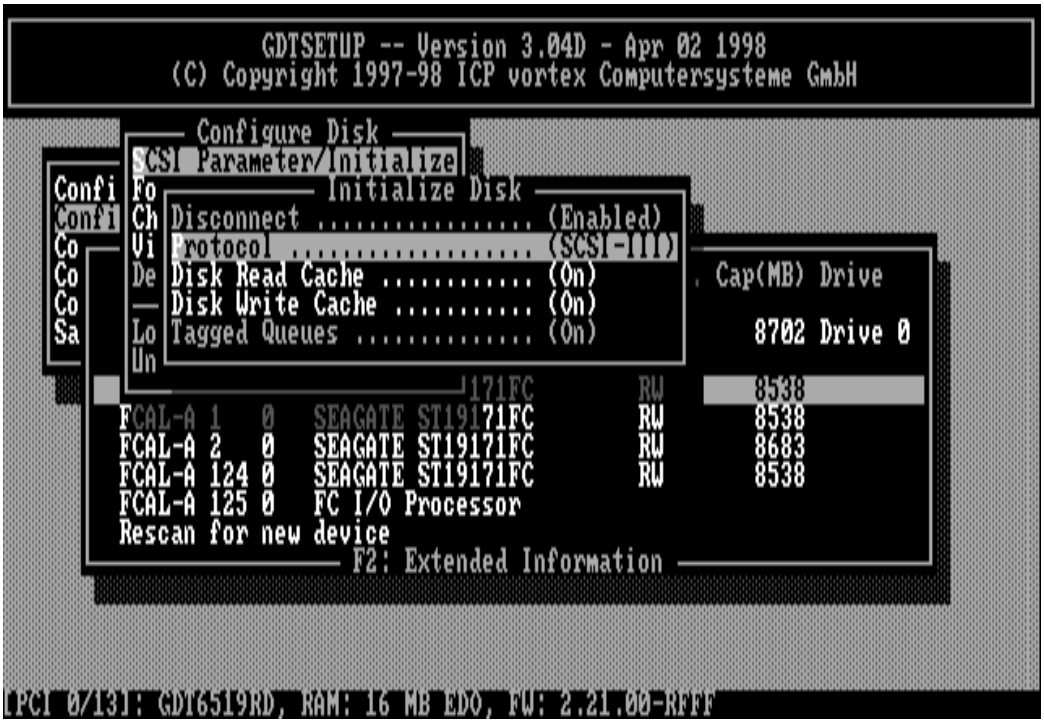
- the I/O channel to which a device is connected (this can be a SCSI or a FCAL channel)
- which ID the drive has (the entry I/O Processor stands for the corresponding I/O channel of the ICP Controller. It has the default ID setting 7 for SCSI and 125 for FCAL).
  The IDs of the FCAL drives are normally assigned through the backplane of the Fibre Channel Enclosure.
- the initialization status
- the names of the drives
- the Read-Write-Status. [RW] = Read + Write
- the gross capacity
- membership in a Logical, Array or Host Drive

Use the cursor keys ↑ and ↓ to select the drive you wish to initialize. We take the first drive of FCAL-A in the list. With this drive selected, press <ENTER>.



(Note: On SCSI-A, ID 0 and ID 6 are devices which are not relevant for our examples).

The *Configure Disk* menu appears which shows various options.
For our example we choose the SCSI P*arameter/Initialize* menu option and press <ENTER>.
The parameters within this menu can be changed by pressing <ENTER> and selecting the new setting.

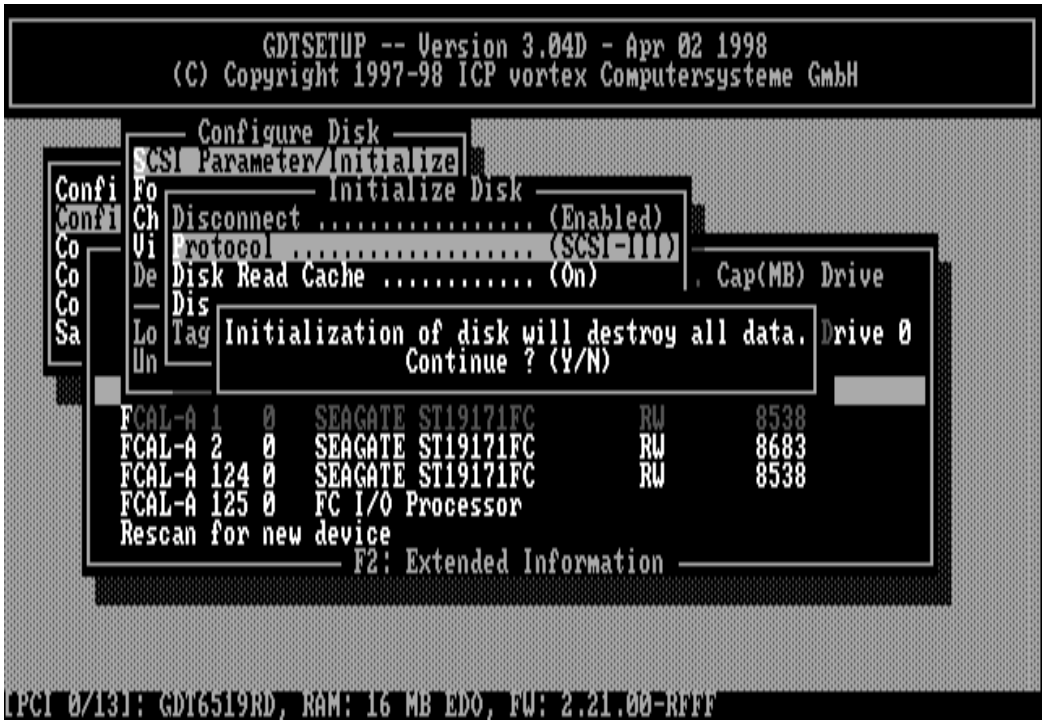


With Fibre Channel devices, there are only view settings which are relevant. They should be "On" or "Enabled". (Note: Fibre Channel devices are also controlled by the SCSI protocol.)

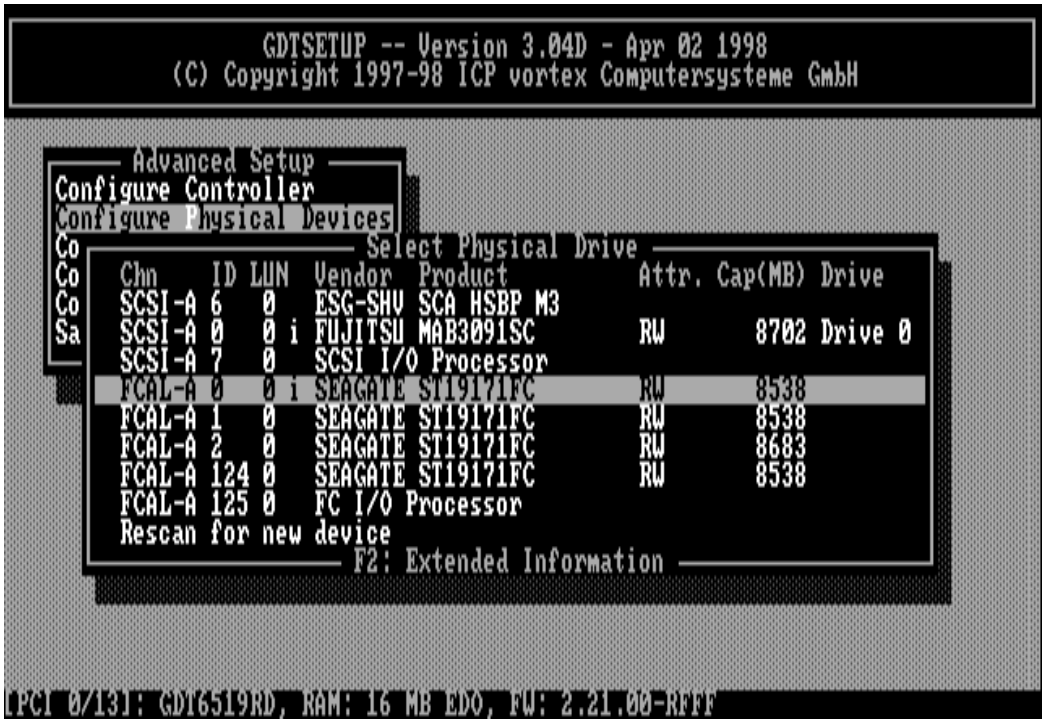
Press <ESC> to leave the SCSI P*arameter/Initialize* menu.
GDTSETUP displays a warning on the destruction of all data. This implies two different evaluations, according to the drive's current state and the options you have selected:

1. F*irst Initialization of the device*. In this case the warning must be taken seriously. If the drive was previously connected to a different controller (e.g., NCR etc.) and still contains data, this data will be lost now.

2. T*he device was already initialized*. If only internal parameters, such as Disconnect, Synchronous Transfer and SCSI-II options have been changed, the data on the drive remains intact. Only the function state of the device is changed.



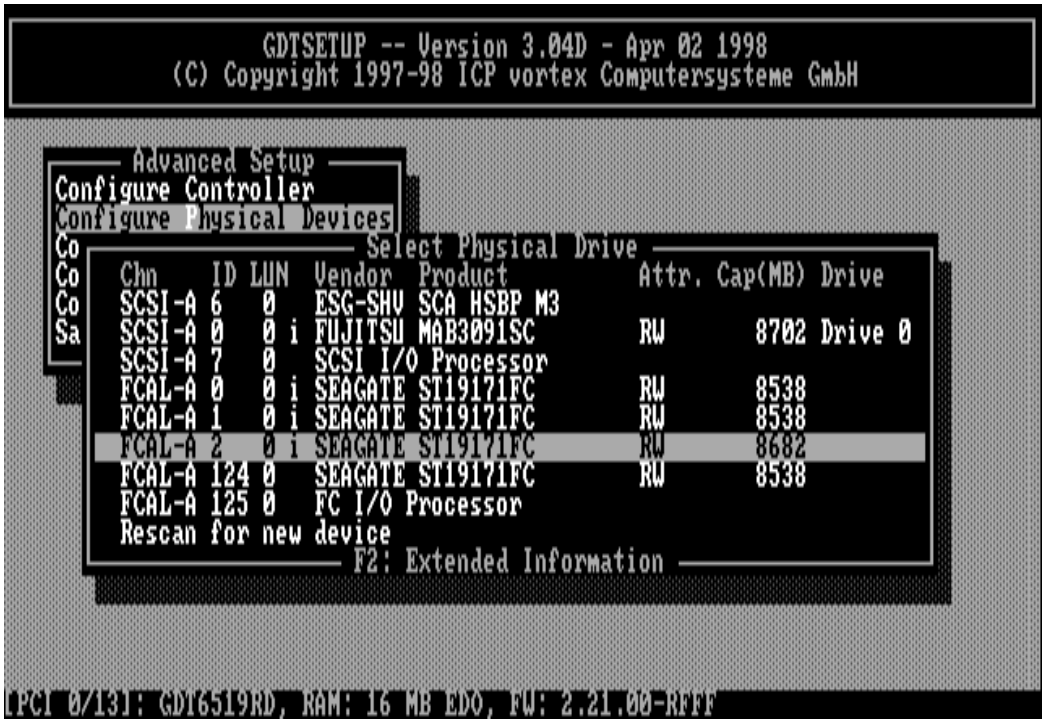
Press <Y> and we are back on the main screen of level 1 and see that the initialization-status of the device has changed.



Initialize the next two SEAGATE drives as described above, that is:

- Select the device with the cursor keys ↑ and ↓ and press the <ENTER>-key
- Choose the settings shown above
- Carry out the initialization

When the initialization completed, the screen should look as follows (a small **i** (i = initialized) must follow the ID of each hard disk):

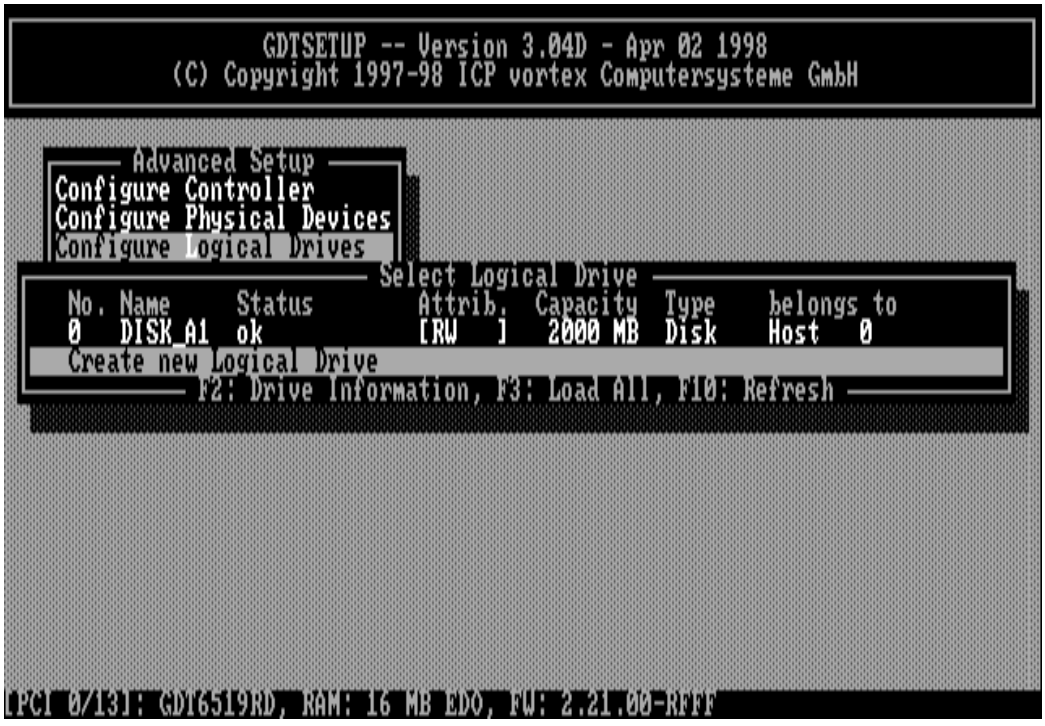


Important: Moving to the next level (Configure Logical Drives) only makes sense if all three devices you need there are initialized.

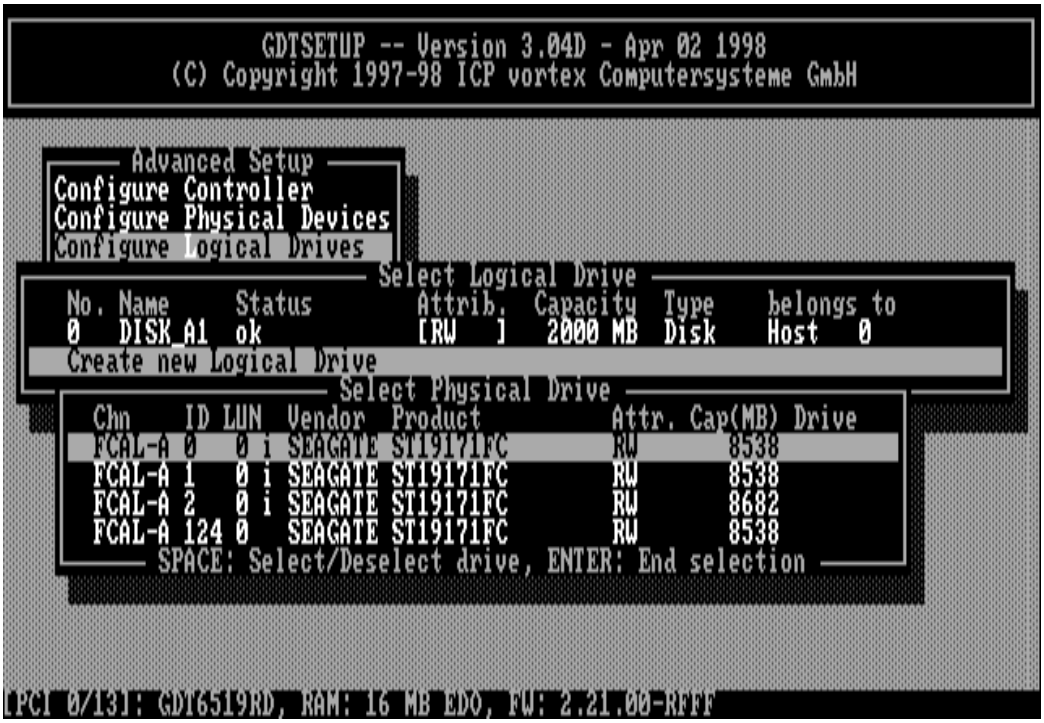
Step 3: Configure Logical Drives

We now leave level 1 (by pressing the <ESC>-key) and are back in the main menu. Now, with the cursor keys ↑ and ↓ select *Configure Logical Drives* and go to level 2 by pressing <ENTER>.

The main screen of level 2 appears. Move the selection bar to *Create new Logical Drives* and press <ENTER> .



Note: The already existing Logical Drive in this list has no relevance for our example.

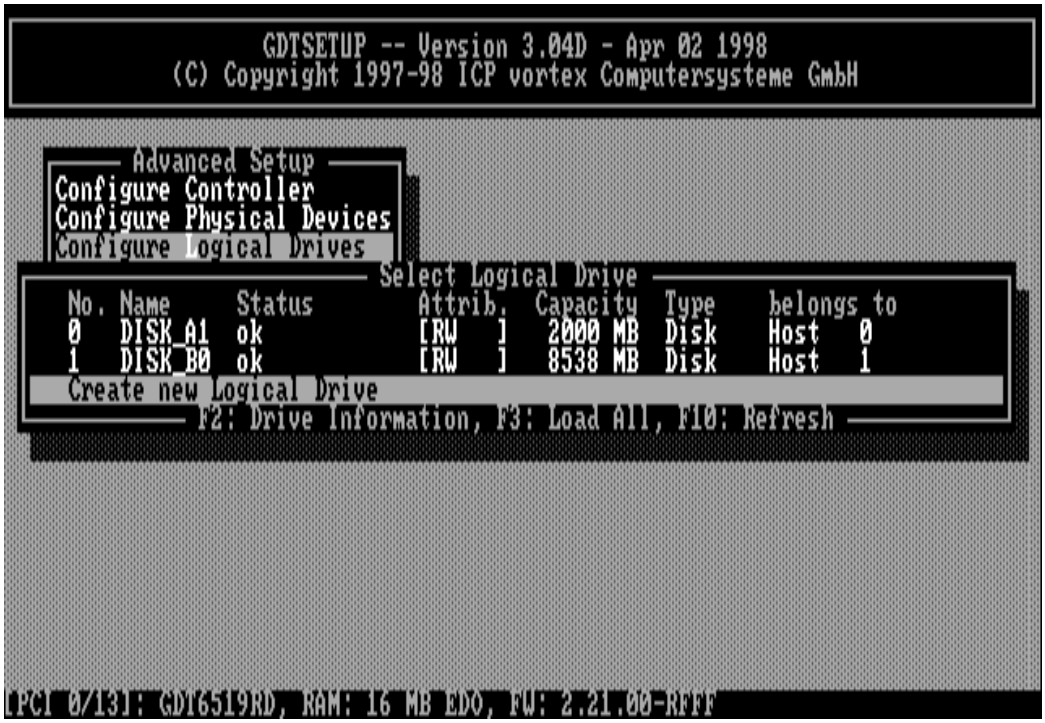


Select the initialized hard disk with the <SPACE>-bar (it becomes marked with an "*") and press <ENTER>.

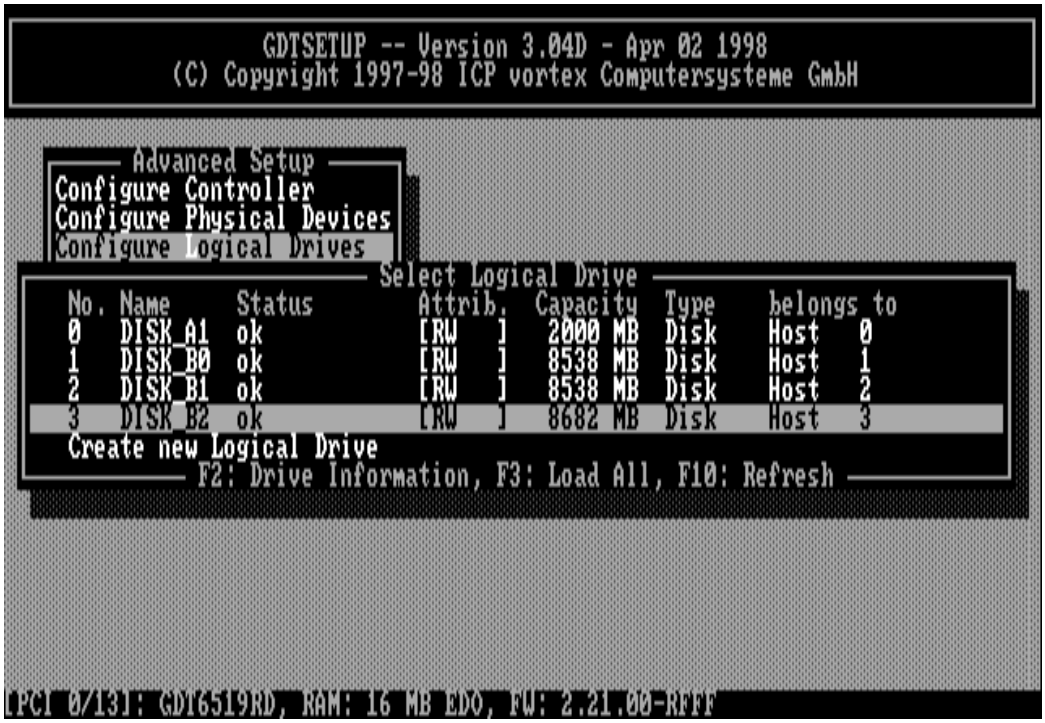
For security reasons, you will be asked again if you want to use the selected disk to create a Logical Drive. As we are sure of our choice, we confirm with <Yes>. GDTSETUP allows you to limit the hard disk size for this Logical Drive. This becomes interesting when you configure disk arrays and you want to make sure that future drives you want to bring into the disk array (e.g., for the capacity expansion or for replacement purposes) fit. It would be bad luck if the new drive only had 8537MB. GDTSETUP couldn't accept it. To avoid this occuring, you could limit the capacity of each drive to 8000 MB. Any new 9 GB drive must have at least

this capacity. The difference in our example would be lost. For this example we use the full capacity and press <ENTER> .

The dialog box is closed and we are back in the main menu of level 2.



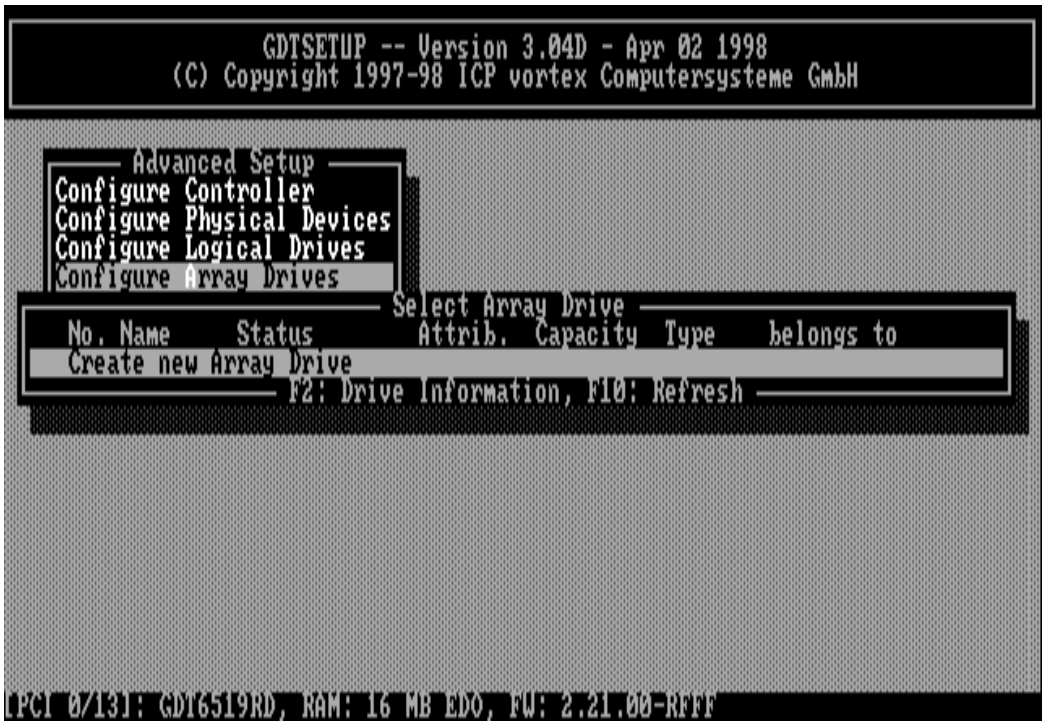
As you can see, we have already created a new Logical Drive of the type D*isk*. The name of the Logical Drive is assigned automatically and contains the I/O channel description and the FCAL-ID after the "_" . This can serve as a reminder when you install a complex system with many drives. (Naturally, you may change the name.). Now configure the remaining Logical Drives one by one. After having completed these procedures for all three Logical Drives, you will see the following screen:



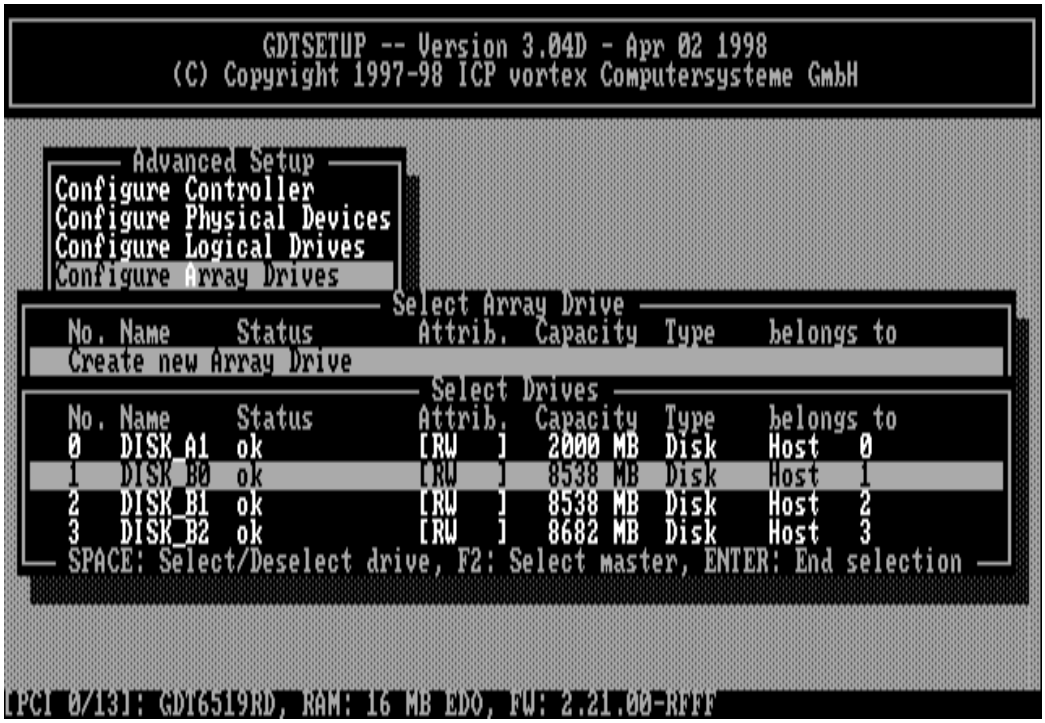
This concludes the installation on level 2. Now press the <ESC>-key to leave this screen.

Step 4: Configure Array Drives

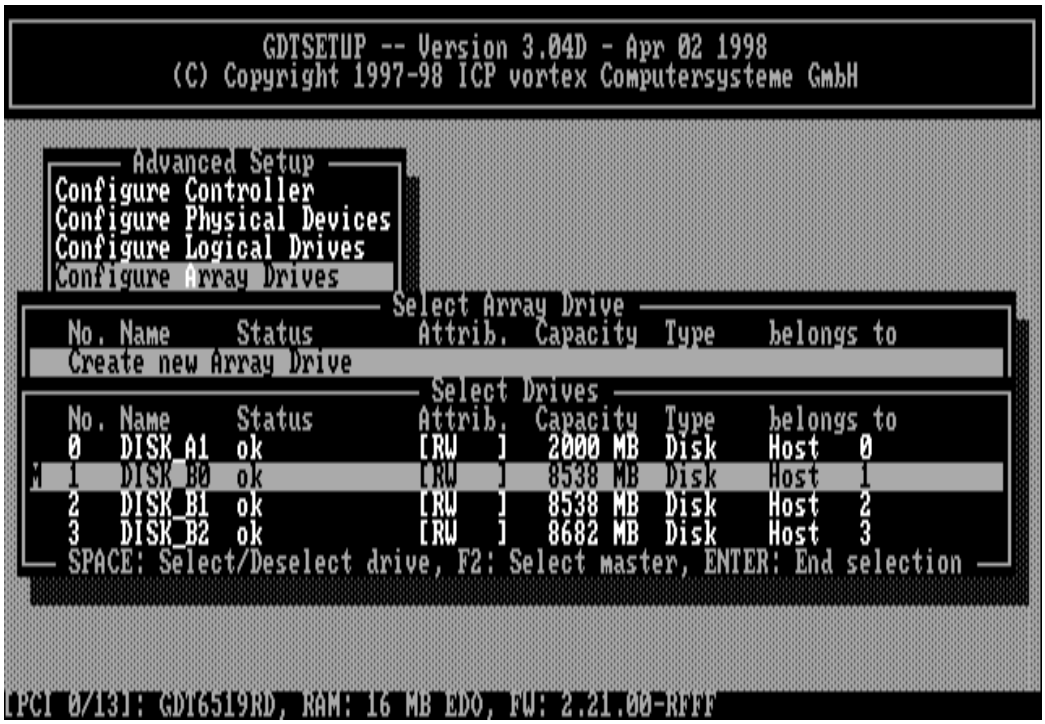
We now leave level 2 (by pressing the <ESC>-key) and are back in the main menu. Now, with the cursor keys ↑ and ↓ select *Configure Array Drives* and go to level 3 by pressing <ENTER>.



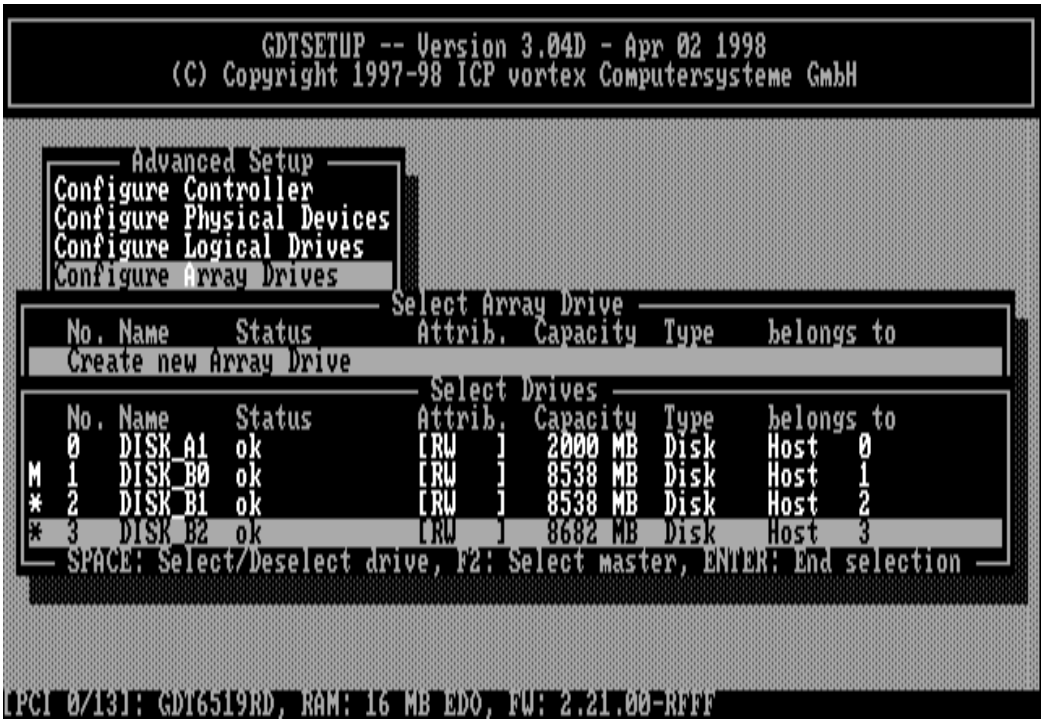
Since we want to create a new Array Drive press <ENTER>.
Note: The first entry in the next list has no relevance for our example.



Move the selection bar to the second entry and press the <SPACE>-bar. The entry is marked with an "M" for Master. This means that the disk array "begins" with this Logical Drive.

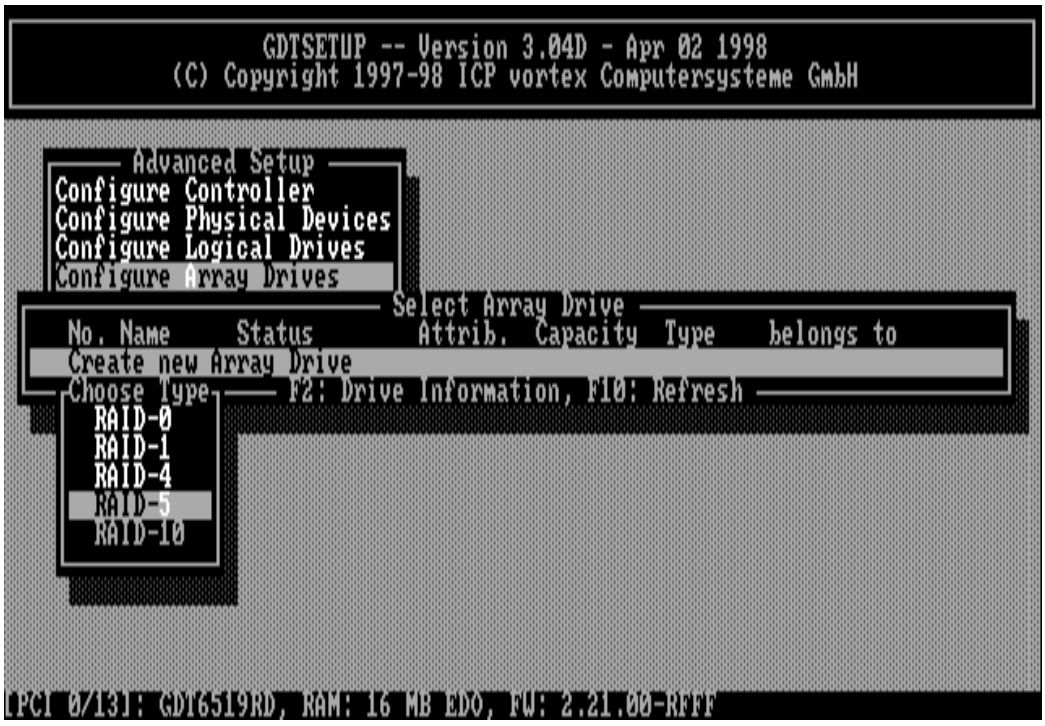


Move the selection bar with the cursor key ↓ to the next entry and press the <SPACE>-bar, again. It is marked with an "*"(pressing the <SPACE>-bar again undoes your choice). Repeat this selection until all three Logical Drives are marked.

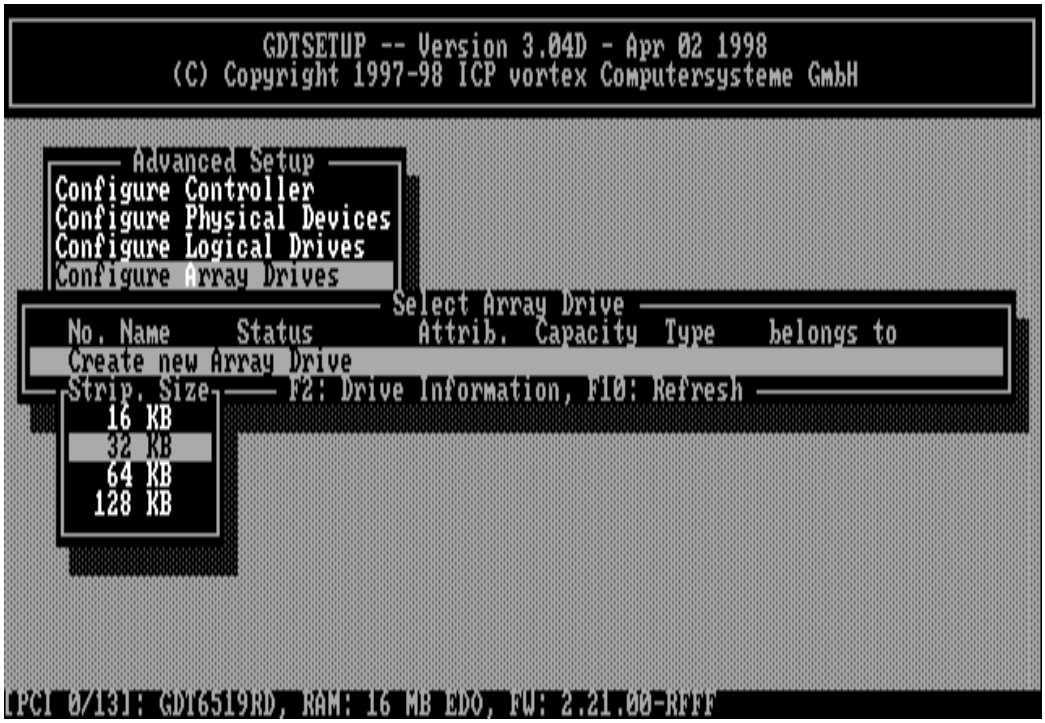


When the last Logical Drive is selected, confirm with <ENTER>. GDTSETUP now displays a list of possible RAID levels available with the number of Logical Drives selected.

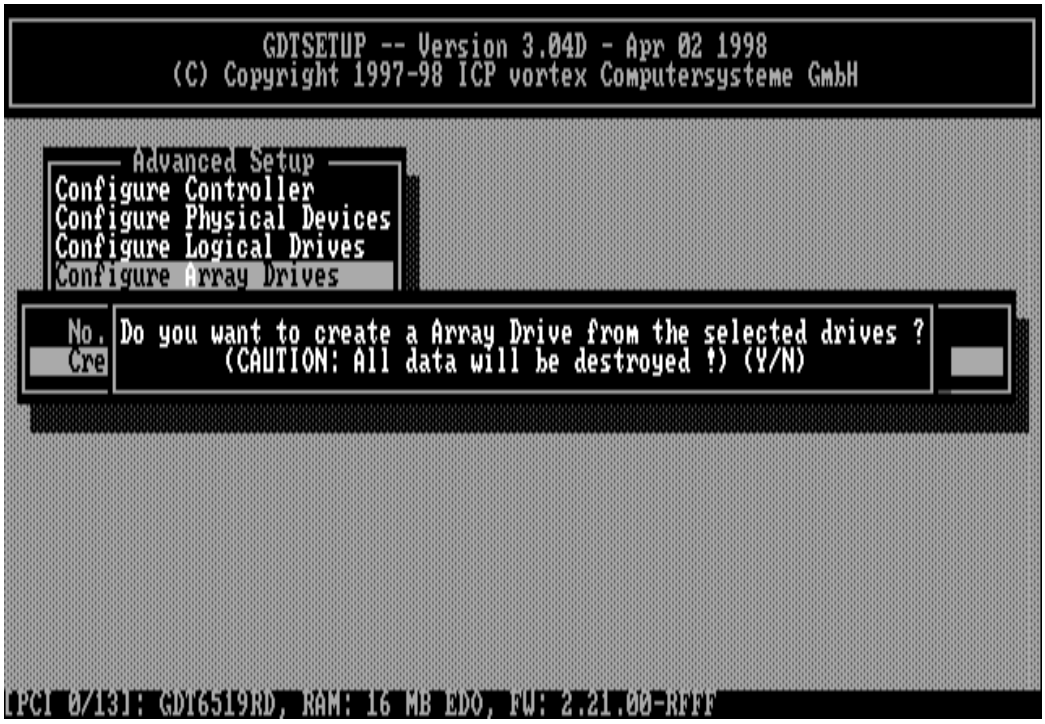
- RAID 0 pure data striping without redundancy
- RAID 1 disk mirroring
- RAID 4 data striping with dedicated parity drive
- RAID 5 data striping with striped parity
- RAID 10 RAID 0 combined with RAID 1



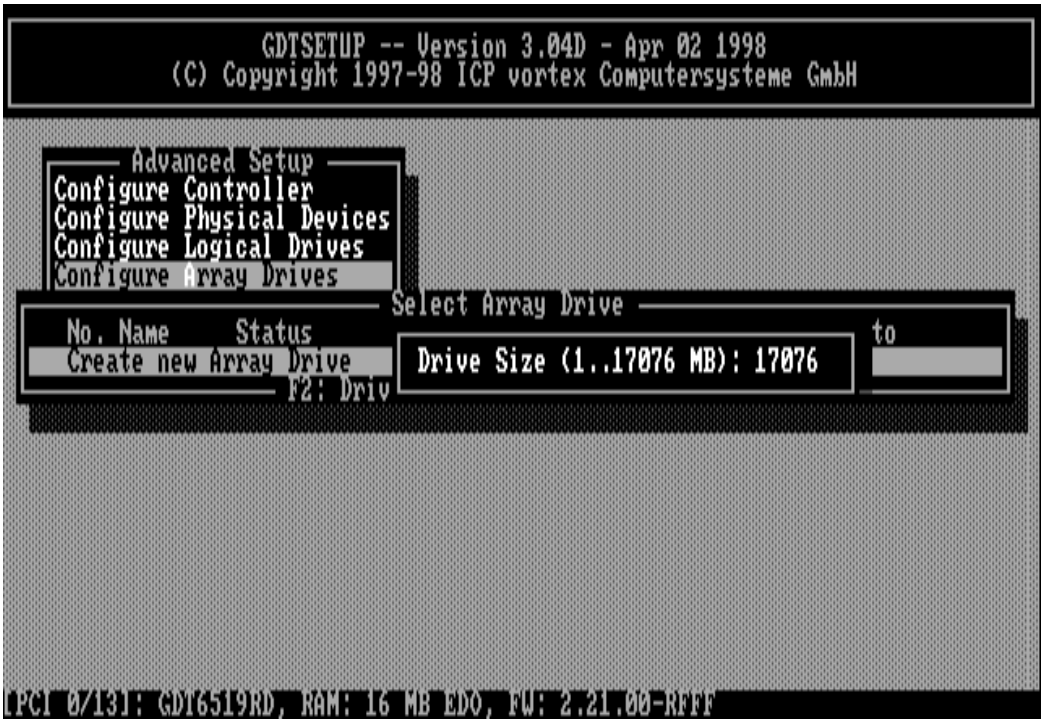
In our case we take RAID-5 and press <ENTER>.

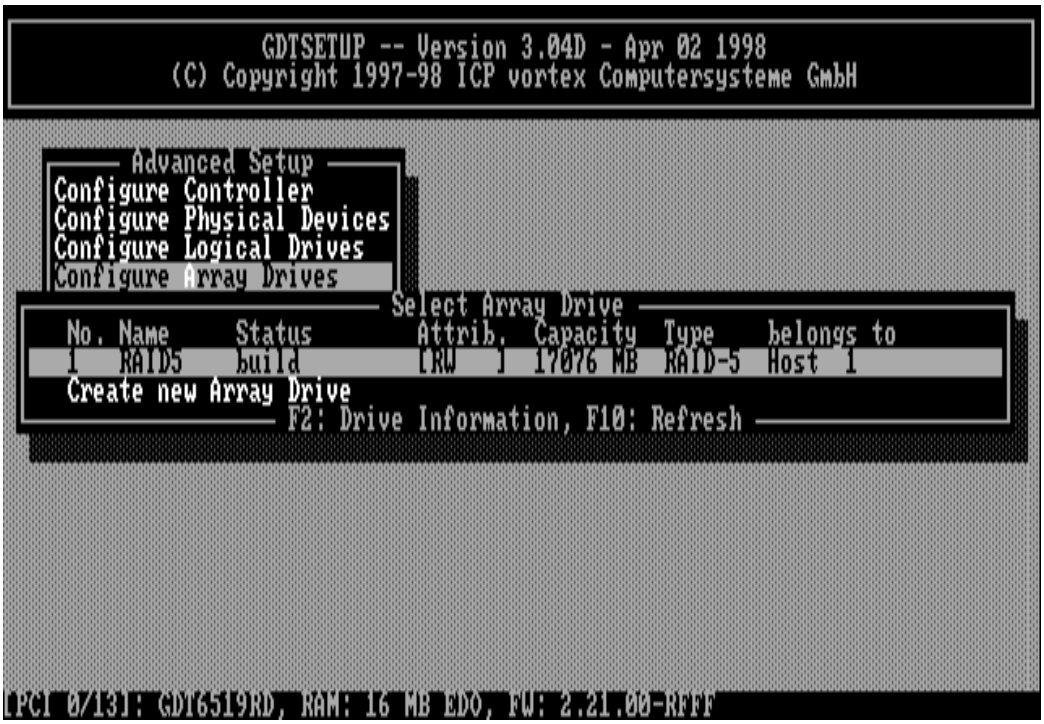


GDTSETUP asks for the *Stripe Size*. This is the size of the stripes into which the data is divided. The default is 32KB which we leave for this example and therefore press <ENTER>. (Note: 32KB stripe size is suggested because in various performance tests it has proved to be the best value.). GDTSETUP displays a security request, which we confirm with <Y>.



GDTSETUP allows you to limit the capacity of the disk array. This may be of interest if your installation requires an exact size for a disk array. Normally, the full capacity is used. In our example we press <ENTER> .



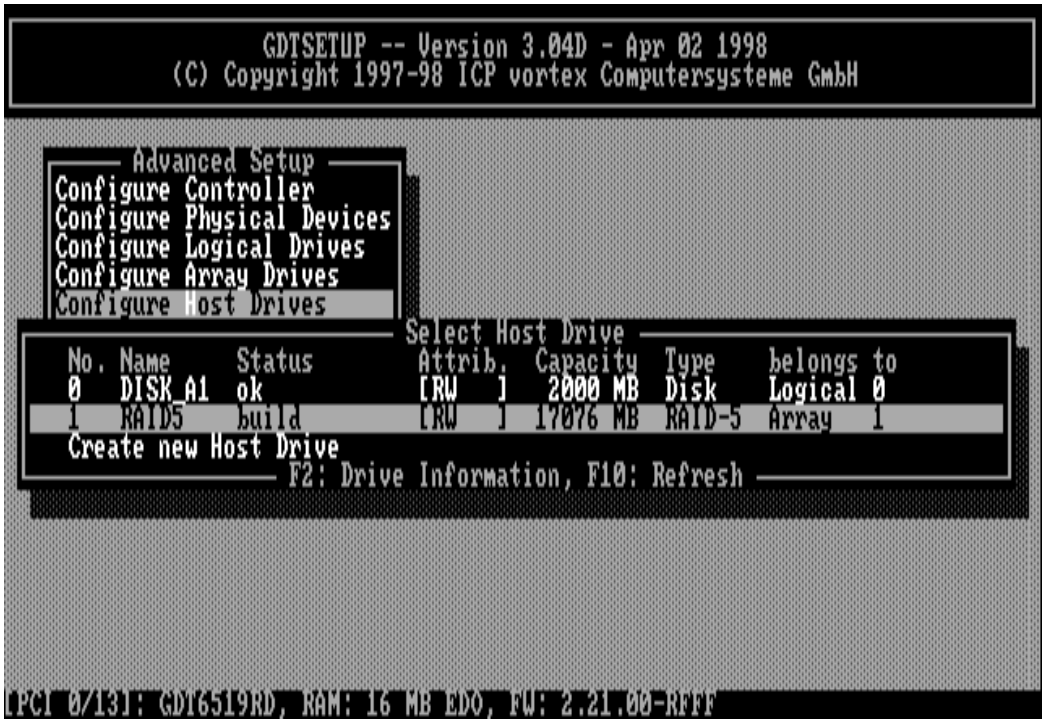


It's done !
We succeeded in setting up a RAID 5 disk array. The screen shows that the disk array is currently in an *build* state. Later in this chapter, we shall explain the different states a RAIDYNE® disk array can assume.
We are now back in the main menu of GDTSETUP.

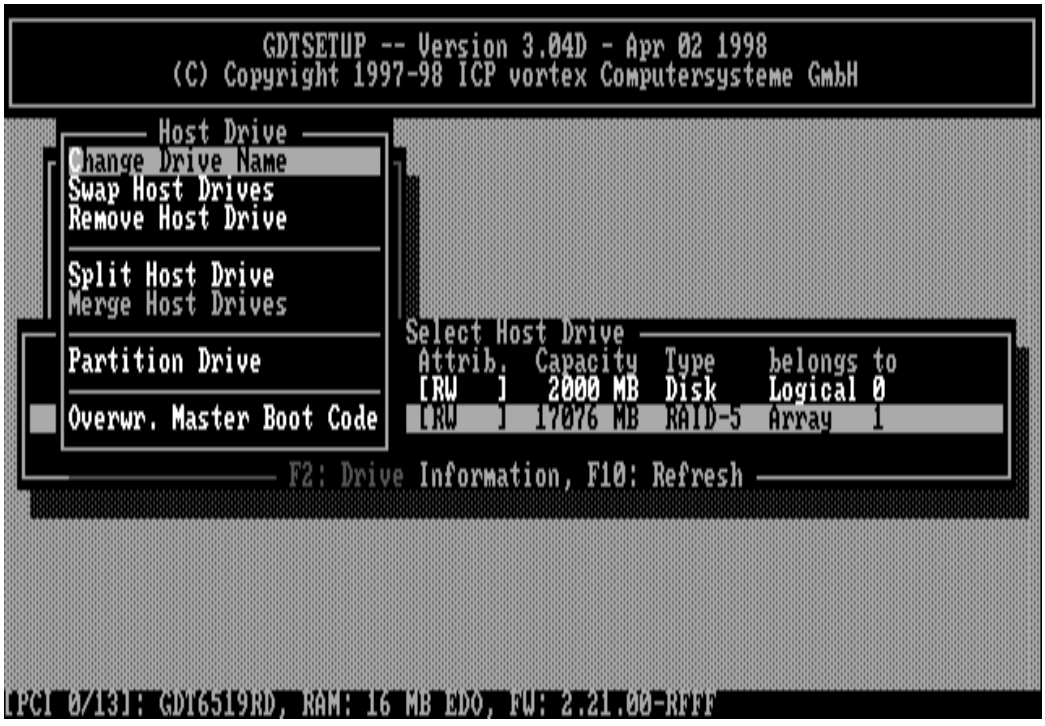
Step 5: Configure Host Drives

We are now back in the main menu of GDTSETUP and select *Configure Host Drives*.
The main screen of level 4 appears. Press <ENTER> . A list of available Host Drives is displayed. Again, the first entry is not relevant for our example.

At position 1 we find our previously configured RAID-5 disk array. It was automatically transformed into a Host Drive, thus for this example we have nothing to do in this menu.



Press <ENTER> to get a list of possible menu options.



We should not forget to mention that if you would have selected *Create new Host Drive*, this would have lead you to exactly the same menu as the Express Setup mode.
But this example is an exercise which should help you to gain a better understanding of how the ICP Controller and GDTSETUP work.

By the way, if you have loaded GDTSETUP from the Flash-RAM (<CTRL><G>) the P*artition* D*rive* option will be missing in this menu. The reason is that partitioning makes no sense, when there is no operating system loaded and the INT13H extension of the ICP Controller has not yet been activated.

Step 6: Leaving GDTSETUP

We are now back in the main menu of GDTSETUP. The installation is completed, and we therefore leave GDTSETUP by pressing the <ESC>-key. The following message appears:

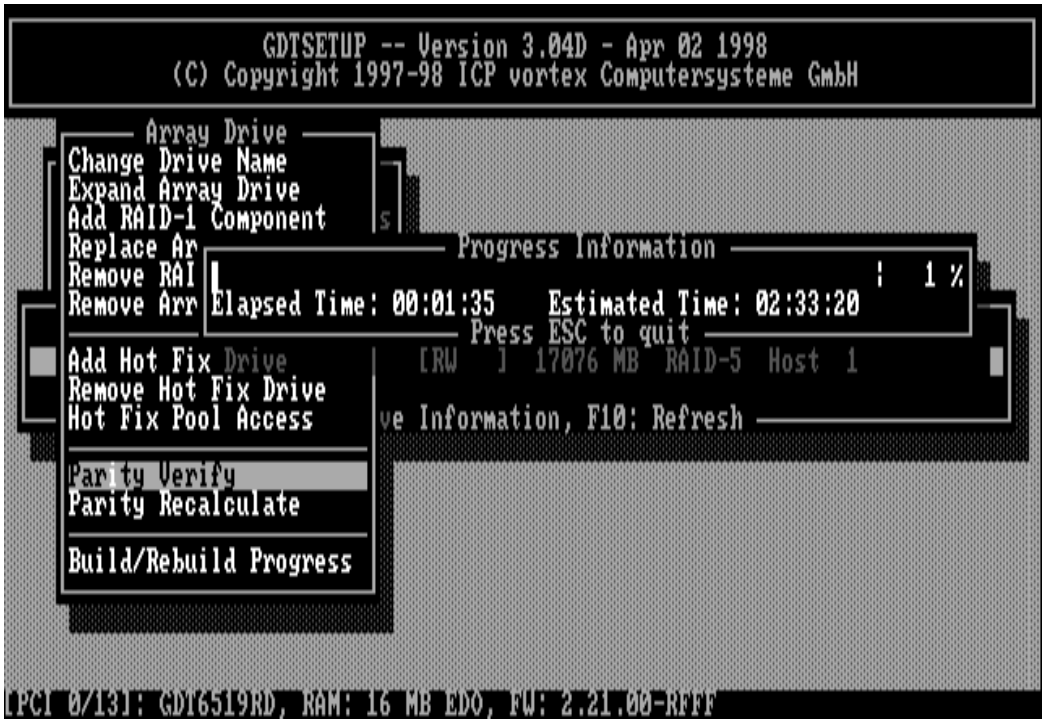
As we are done with the installation and therefore definitely want to leave GDTSETUP, we press any key.

IMPORTANT: Always end GDTSETUP by leaving the program in the regular way (do not warm-boot with CTRL-ALT-DEL or cold boot by pressing the RESET button). Certain information is only transferred to the controller when you leave GDTSETUP in the regular way.

After rebooting the system, load GDTSETUP anew. Change to the Advanced Setup menu, select C*onfigure* A*rray* D*rives*, and press <ENTER> .
Select the Array Drive, press <ENTER> and move the selection bar to the B*uild/Rebuild progress* menu. Press <ENTER> .

From the progress information slider, we can easily see, that the 17 GB disk array is already built up 2% and that the estimated time for the build process is 43 minutes.
Note: During the build process the disk array is fully operational, but not yet redundant. I.e., you could immediately start installing your desired operating system, without having to wait until this process has finished.
At the end of this build process the disk arrays state becomes *ready* (fully redundant).

Now press <ENTER> and move the selection bar to the *Parity Verify* menu. Press <ENTER>.



RAIDYNE® now checks the correctness of the redundancy information (i.e., calculates the redundancy information anew and compares it with the already existing information). Depending on how large the disk array is, this check may take quite a long time, however, it can be aborted by pressing <ESC>. P*arity Verify* is a diagnosis function which enables you to verify the consistency of a disk array every now and then. We interrupt the verification by pressing <ESC>. Note: The ICP monitor program **GDTMON** and the **ICP RAID Navigator** also include the parity verify function. Unlike in GDTSETUP, the disk array's parity can be checked while the disk array is fully operational (e.g., in a NetWare file server).

Step 7: Simulating a Drive Failure

This part of our example is optional. Nevertheless, we recommend that you go through it. It gives you a better understanding of how RAIDYNE® reacts in the event of a drive failure and what you have to do in such a case.

I*mportant*: To carry out the drive failure simulation, the disk array must be in the *ready* state. Only in this state, has the disk array redundancy.

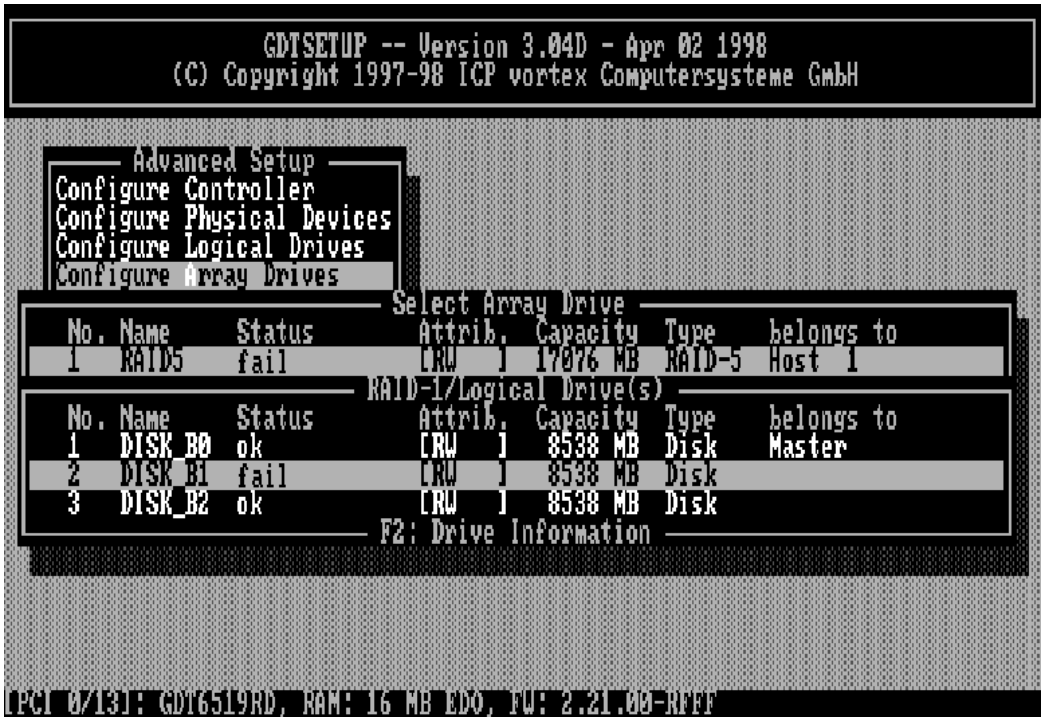
In order to make the simulation as realistic as possible, we suggest creating an MS-DOS-partition on the disk array with FDISK. To create disk activity, write a small batch program which copies data from one directory of this partition to another. While the copy process is going on, we simulate a drive failure of drive DISK_B1 by removing the drive's DC power supply cable. Now we can observe how RAIDYNE® reacts:

1. After a short time, the acoustical alarm of the ICP is activated. (Note: this alarm is only activated when the RAID 5 Array Drive is being accessed).

2. RAIDYNE® activates the so-called *fail* operation state during which the disk array remains fully operational. The data of the failed drive is calculated by means of the redundant data stored on the other drives.

The alarm signal does not switch off because the disk array, although operational, is found in a state without redundancy, that is, a state which should be eliminated as soon as possible. The alarm signal turns off when GDTSETUP is loaded.

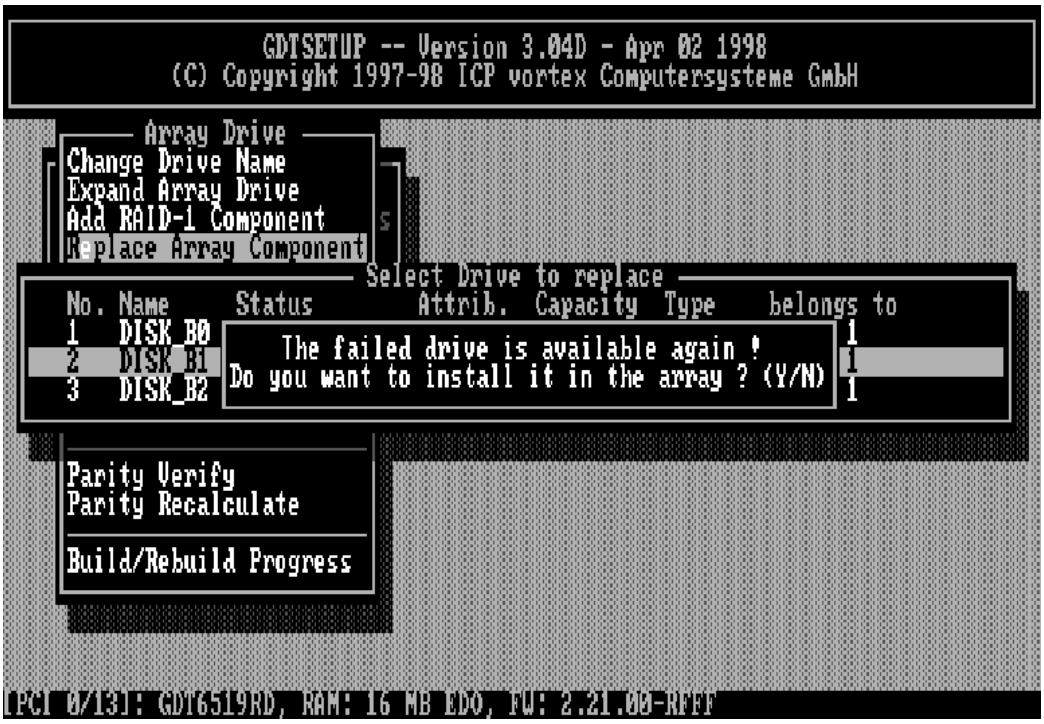
How is this situation reflected in GDTSETUP ?
What has happened to the failed hard disk ?
To answer these questions, we load GDTSETUP and check. We go to the menu *Configure Array Drives* menu and select our RAID-5 disk array which entered the *fail* state. Press <F2> to get further information on the failure.



After selecting the failed Logical Drive, press again <F2> to obtain detailed information on the physical drive which has actually failed.

Important: Even if we reconnected the power supply to DISK_B1 before loading GDTSETUP, DISK_B1 would not be included in the disk array again. If you decide to use the failed hard disk again, it is best if you reconnect the drive to the power supply and do a cold boot. After loading GDTSETUP select the *Configure Array Drives* menu. Select the *Replace Array Component* menu

Press <ENTER> . GDTSETUP recognizes the previously failed drive again (it was not really defective) and asks if it should be integrated into the disk array again.



Answer <Yes> and the disk array changes its state into *rebuild*. After leaving GDTSETUP the controller begins the reconstruction of the data of the failed drive.
After the completion of this process, the disk array's state changes into *ready* again.

A few words on the replacement of a defective hard disk of a disk array.
If a hard disk belonging to a disk array for which no Hot Fix drive had been assigned should fail, you should replace this defective hard disk with a new one *as soon as possible*. Always be aware of the fact that this disk array does not have any redundancy until the defective hard disk has been substituted. This means that if another hard disk should fail while the disk array is without redundancy, all data is irretrievably lost. RAIDYNE® offers two possibilities of replacing a failed drive of an array for which no Hot Fix drive has been designated:

1. Replacement with GDTSETUP (we have just demonstrated this method)
2. Replacement by using the **Hot Plug function** of **GDTMON** and **ICP RAID Navigator**

The Hot Plug method allows you to replace a defective drive while the disk array continues to work and without having to load GDTSETUP. When this method is used, the I/O channel to which the defective drive is connected, is temporarily halted (that is, for the time necessary for replacement). After the replacement RAIDYNE® automatically begins to rebuild the new drive. The halting and release of the I/O channel is controlled by GDTMON or ICP RAID Navigator. This halt of the I/O channel serves to avoid that interferences impair the functioning of still intact drives on this channel.

We would like to stress that the Hot Fix method is by far the most secure method of replacing a defective drive while the disk array is operational (see next example). First of all, because it is completely automatic, and secondly because it does not imply any mechanical or electrical interventions on the disk array as the Hot Plug method does.
We shall explain GDTMON and the Hot Plug method more thoroughly later in this manual.

C.9 Example 4 - RAID 5 Disk Arrays With a Hot Fix Drive

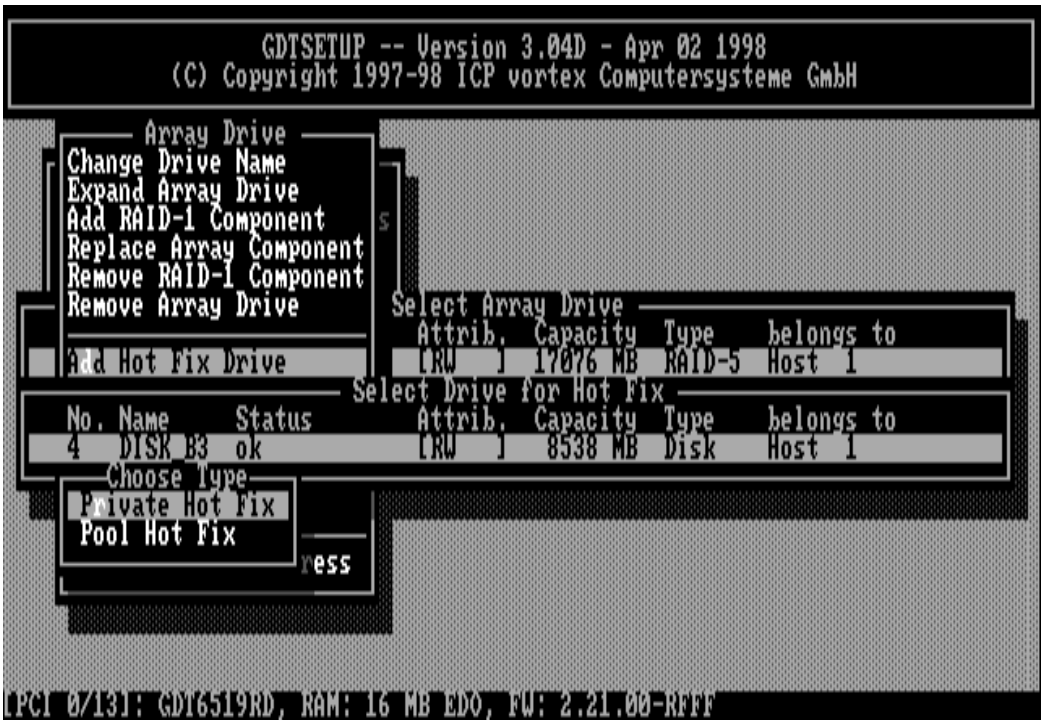
What we call **Hot Fix** drives is referred to as **Host Spare** drives in some literature. Most part of the installation is carried out as in our third example, so we do not repeat the explanation.
Do Step 1, Step 2, Step 3 and Step 4 as described in example no. 3.
In addition, initialize the fourth Seagate drive and make a Logical Drive out of it.

Step 5: Creating a Hot Fix Drive

Select the Array Drive in the *Configure Array Drives* menu and press <ENTER> . Move the selection bar to the *Add Hot Fix Drive* menu.

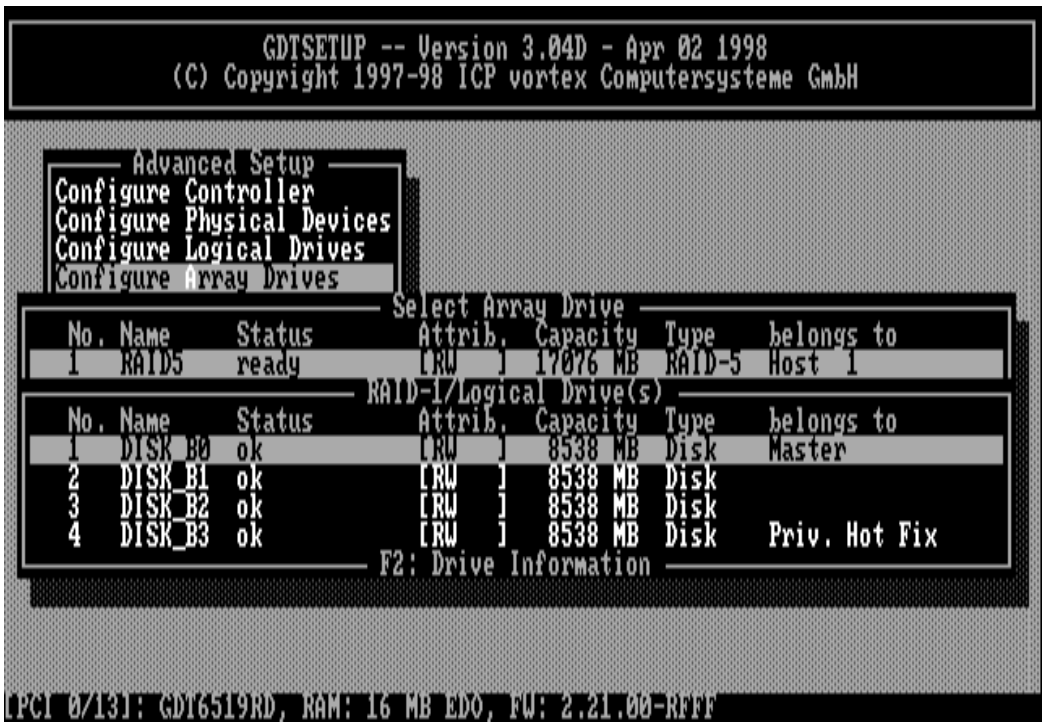
Press <ENTER>. GDTSETUP now displays a new dialog-box containing all the Logical Drives apt to serve as a Hot Fix drive (one criterion for this suitability is the drive's capacity, i.e., it has to be large enough). So do not be surprised if you do not find all the drives you would have expected during later installations. GDTSETUP knows which drives are suitable to be used as Hot Fix drives.

Press <ENTER>.



GDTSETUP offers two different Hot Fix types: A *private* Hot Fix drive is only available for one specific disk array. A Hot Fix drive in a Hot Fix P*ool* can be made available to several disk arrays (presuming that the capacity fits). In our example we choose the P*rivate* H*ot* F*ix* drive and press <ENTER> .

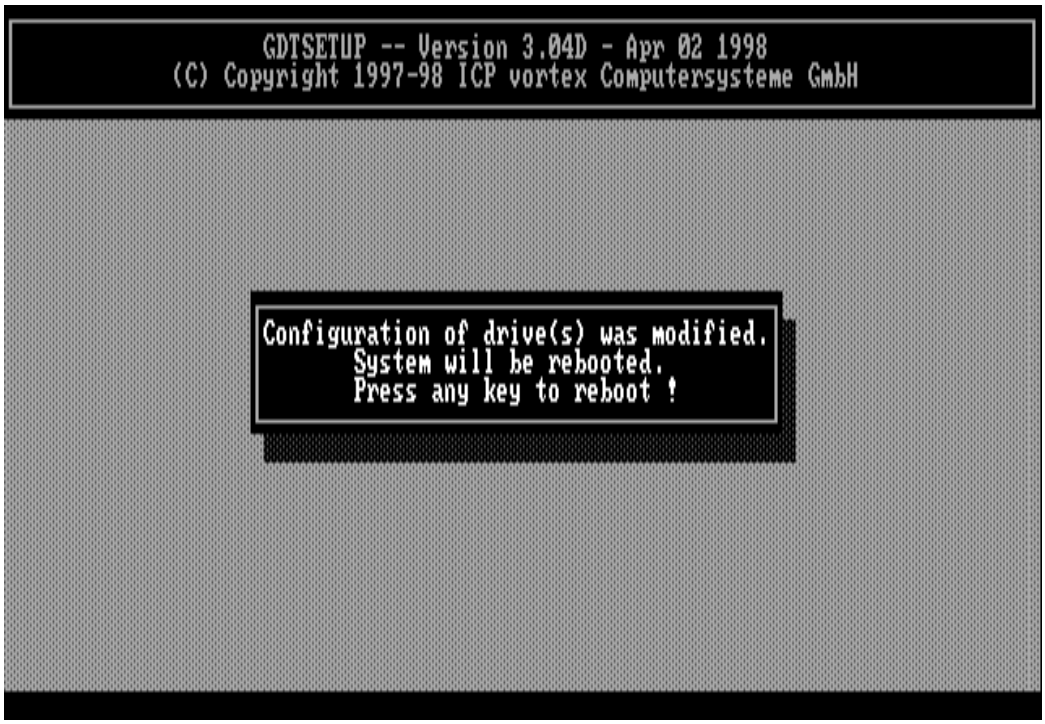
Attention: By turning a Logical Drive into a Hot Fix drive, all its data is irretrievably lost.



After pressing <F2> we get detailed information on the structure of the disk array. The last entry refers to the *Priv. Hot Fix* drive.
We have already seen this form before, with the only difference that DISK_B3 has been assigned to be the Hot Fix drive. We now leave GDTSETUP as described in example no. 3, in order to allow GDTSETUP to send all relevant information to the controller and let RAIDYNE® create and store the redundant information.

Step 6: Leaving GDTSETUP

We are now back in the main menu of GDTSETUP. The installation is completed, and we therefore leave GDTSETUP by pressing the <ESC>-key. The following message appears:



As we are done with the installation and therefore definitely want to leave GDTSETUP, we press any key.

IMPORTANT: Always end GDTSETUP by leaving the program in the regular way (do not warm-boot with CTRL-ALT-DEL or cold boot by pressing the RESET button). Certain information is only transferred to the controller when you leave GDTSETUP in the regular way.

***The question that arises now is*:**

When and how does the Hot Fix mechanism work ?
Normally, RAIDYNE® puts Hot Fix drives in a stand-by mode, that is, their motors are stopped. However, it may happen that certain operations such as loading drivers, starting GDTSETUP and so on, cause the Hot Fix drives to start their motors. This takes a little Bit longer, but it is necessary in order to enable RAIDYNE® to check the consistency of the setup. RAIDYNE® substitutes a failed hard disk with a Hot Fix drive only if the array was in a *ready* state before the failure. Or, in other words, a Hot Fix drive can only be activated if the corresponding disk array was in a state of data redundancy at the moment of failure.
Important: The following partial step can only be performed if the disk array is in the *ready* state.

Step 7: Simulating a Hard Disk Failure When a Hot Fix Drive is Present.

This partial step is optional. However, we recommend that you carry it out in order for you to get an idea of how RAIDYNE® reacts in such a situation and which steps need to be taken. To have a very realistic simulation, create a DOS-partition and generate load on your disk array by using a batch file with copy commands. During these copy operations we cause DISK_B2 to fail by plugging out its power supply.

We now observe how RAIDYNE® reacts:

1. After a short while, ICP's alarm signal is heard.
   (Note: the alarm only goes on when the RAID 5 Array Drive is accessed.)

2. RAIDYNE® activates the so-called *fail* operation mode. In this mode, the disk array remains fully operational. The data of the failed drive is reconstructed by means of the redundancy information stored on the other drives.

3. RAIDYNE® starts the motor of the Hot Fix drive.

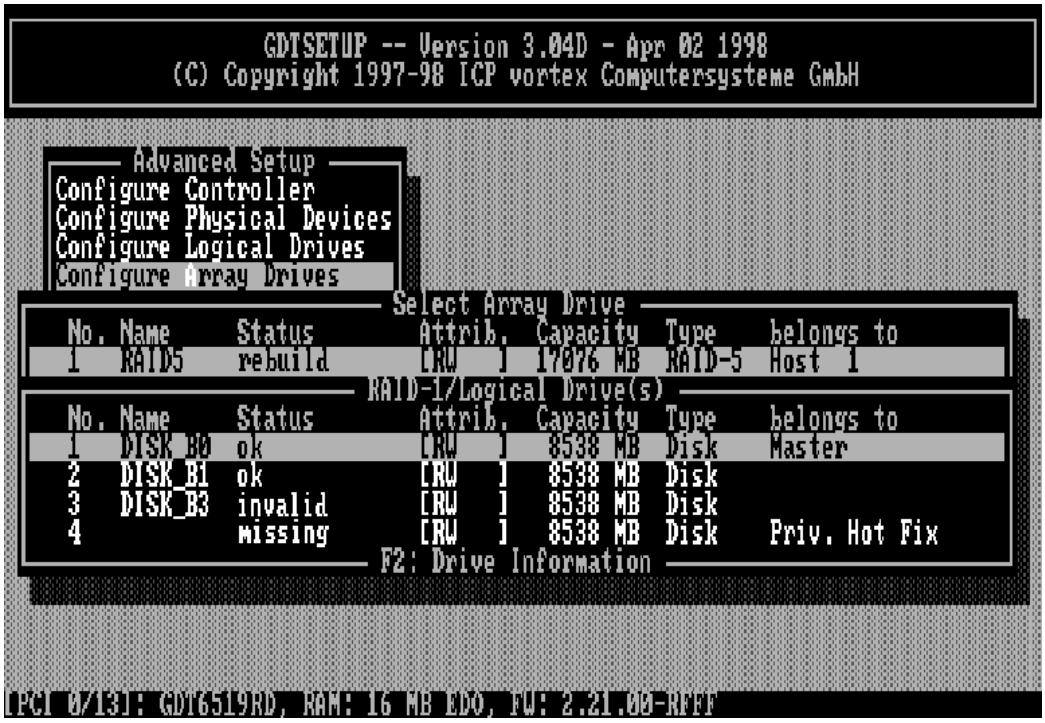
4. RAIDYNE® includes the Hot Fix drive into the disk array and starts to reconstruct the data and redundancy information. The disk array is now in the operation mode *rebuild*.

5. The alarm signal is not turned off until a new Hot Fix drive is added to the disk array, or until GDTSETUP (or GDTMON) is loaded and the missing Hot Fix drive is removed or replaced with a new one.

Obviously, no other hard disk may fail until all data is entirely reconstructed on the Hot Fix drive, because up to that moment the system operates without redundancy.

How is this situation reflected in GDTSETUP?
What has happened to the failed drive ?

To answer these we load GDTSETUP and check. We go directly to the menu *Configure Array Drive* menu. As expected, the disk array is in the *rebuild* state. Request the drive information regarding the RAID5 disk array with <F2>.



Two changes have occurred. The Hot Fix drive DISK_B3 has the state *invalid* and has jumped into the position of DISK_B2 (it will change its status from invalid to OK as soon as the Array Drive is becoming *ready* again). DISK_B2 is missing (this is the drive we let fail (disconnected it from the DC power)). Since this disk array was configured to have a hot fix drive, this position is still in the list, with the attribute *missing*.

C.10 Trying to Answer The Initial Questions

Now, after having demonstrated with examples 3 and 4 how RAID disk arrays are created with RAIDYNE® (we hope you enjoyed it), we would like to return to the questions set down at the beginning of this chapter. When planning a disk array it is essential that you have precise ideas on how you intend to configure the disk array.

C.10.1 How Many Hard Disks Should be Integrated Into the Disk Array ?

To answer this question let us have a look at the delimiting parameters, that is, the maximum and minimum number of drives. The **maximum number** of physical drives in a disk array is determined by the number of physical drives the ICP Controller can control. In this context, we cannot analyze the many various factors which influence the decision of whether to integrate all Host Drives into one single RAID Host Drive, or rather create a number of smaller RAID Host Drives instead. The **minimum number** of necessary hard disks depends on the RAID level you wish to realize.

RAID Level	Type of Disk Array	Minimum number of hard disks
RAID 0	data striping	2
RAID 1	disk mirroring	2
RAID 4	data striping with parity drive	3
RAID 5	data striping with striped parity	3
RAID 10	data striping and mirroring	4

The desired usable disk space of the disk array as well as the following two issues have a direct impact on the number of physical hard disks needed.

C.10.2 Which Level of Redundancy is Needed ?

To come straight to the point, **RAID 0** (data striping) does not imply any redundancy at all (the **R** in front of the **AID** is rather misleading). On the other hand, a RAID 0 disk array is pretty fast, since no parity information is required. With **RAID 1** (disk mirroring), the data is 100% redundant because it is mirrored. This is definitely the highest level of redundancy, but the most expensive one, too. An interesting combination of RAID levels 0 and 1 is **RAID 10.** Two RAID 0 stripe sets are simply mirrored. If one drive fails, the data are still available on the mirrored drive. With **RAID 4** (data striping with dedicated drive) and **RAID 5** (data striping with striped parity), parity information is calculated from the present data with a simple mathematical operation (eXclusive OR, XOR), and stored either to one dedicated drive (RAID 4) or to all drives (RAID 5). If one drive should fail, the data of the defective drive can be reconstructed on the basis of the normal user data and the previously calculated parity data. RAID levels 4, 5 and 10 can tolerate the failure of one drive just as RAID 1, but in comparison to the latter, RAID 4, RAID 5 or RAID 10 are less expensive. As already mentioned before, the entire disk array controlling function is carried out at controller level and therefore does not load the host computer. Let us have a look at the following table which explains the correlations between the RAID level, usable disk capacity and number of physical hard disks. To make things easier, we consider identical 1 GB hard disks:

RAID Level	2 hard disks	3 hard disks	4 hard disks	5 hard disks
RAID 0	2GB	3GB	4GB	5GB
RAID 1	1GB	1GB	1GB	1GB
RAID 4	-	2GB	3GB	4GB
RAID 5	-	2GB	3GB	4GB
RAID 10	-	-	2GB	-

It is quite obvious that the redundancy of level RAID 1 soon becomes very expensive when more than 2 hard disks are used. Only with RAID 4 and RAID 5 have you a reasonable relation between storage capacity and expenses for the disk array.

C.10.3 Do we Need Hot Fix drives ?

In other words: Should RAIDYNE® automatically reconstruct the lost data after a hard disk failure ?
One of the reasons that have led you to choose **R**AID disk arrays definitely lies with the **r**edundancy, that is, the data security you still preserve even in the event of disk failure, thus resting assured against loss of data and time. Hot Fix drives are possible with all RAID 1, 4, 5 and 10 disk arrays. In order to assist the following considerations, we define the term ***time without redundancy*, TWR**. Set apart the time needed to set up the disk array (state *build*), the time without redundancy should be kept as short as possible. Let us assume that one of the hard disks of the RAID 5 disk array we set up with example 1 fails. The disk array is without redundancy. TWR starts to run. Any superfluous prolongation of the TWR (because you have to get a replacement drive, or because you did not realize the failure immediately since you didn't hear the ICP Controller's alarm signal, or because nobody checked the file server) increases the risk of data loss which will occur if a second drive should fail. Therefore, new redundancy should be created as soon as possible and in an entirely automated manner. Integrating a Hot Fix drive as an immediately available and auto-replacing drive is the only way to keep the TWR as short as possible. Only a Hot Fix drive can ensure optimal disk array security and constant data availability. Of course a Hot Fix drive is not compulsory. If you control the disk array at regular intervals and immediately replace a defective drive (by shutting down the system or hot-plugging), you can do without a Hot Fix drive.

C.11 States of a RAIDYNE® Disk Array

An Array Drive under the RAIDYNE® operating system can assume seven different operational modes: **I*dle*, R*eady*, F*ail*, B*uild*, R*ebuild*, E*xpand and* E*rror*.**

C.11.1 "Idle" State

This state is characterized by the fact that the redundant information of the disk array has never been entirely created. The disk array is in this state after its first configuration and until you quit GDTSETUP. If an error should occur while the array is in the *build* state, the array returns to the *idle* state (exception: if during *build* mode the dedicated drive of RAID 4 fails, the mode changes to *fail*).

C.11.2 "Build" State

After the disk array has been configured for the first time, it assumes the *build* state as soon as you quit GDTSETUP. While the array is in the *build* state, redundancy information is calculated and stored to the hard disks of the array.

C.11.3 "Ready" State

The disk array is fully operational when in the *ready* state. All redundant information is present, that is, a hard disk can fail without impairing the functionality of the disk array. This is the normal state of a disk array. The state *ready/expand* indicates, that the RAID level and/or capacity are currently migrated/expanded.

C.11.4 "Fail" State

The disk array changes to the *fail* state whenever a Logical Drive fails. Redundancy information is still present, thus allowing the remaining hard disks to continue working. This state

should be eliminated as soon as possible by replacing the defective hard disk. If a so-called Hot Fix drive has previously been assigned to a disk array with GDTSETUP, the controller will automatically replace the defective drive and start the reconstruction of the data and the redundant information. Therefore, under these circumstances the *fail* state is only temporary and will be eliminated by the controller itself.

C.11.5 "Rebuild" State

The disk array will assume this state after the automatic activation of a Hot Fix drive or after a manual replacement carried out with GDTSETUP. The data and the redundant information are reconstructed and stored to the new drive.

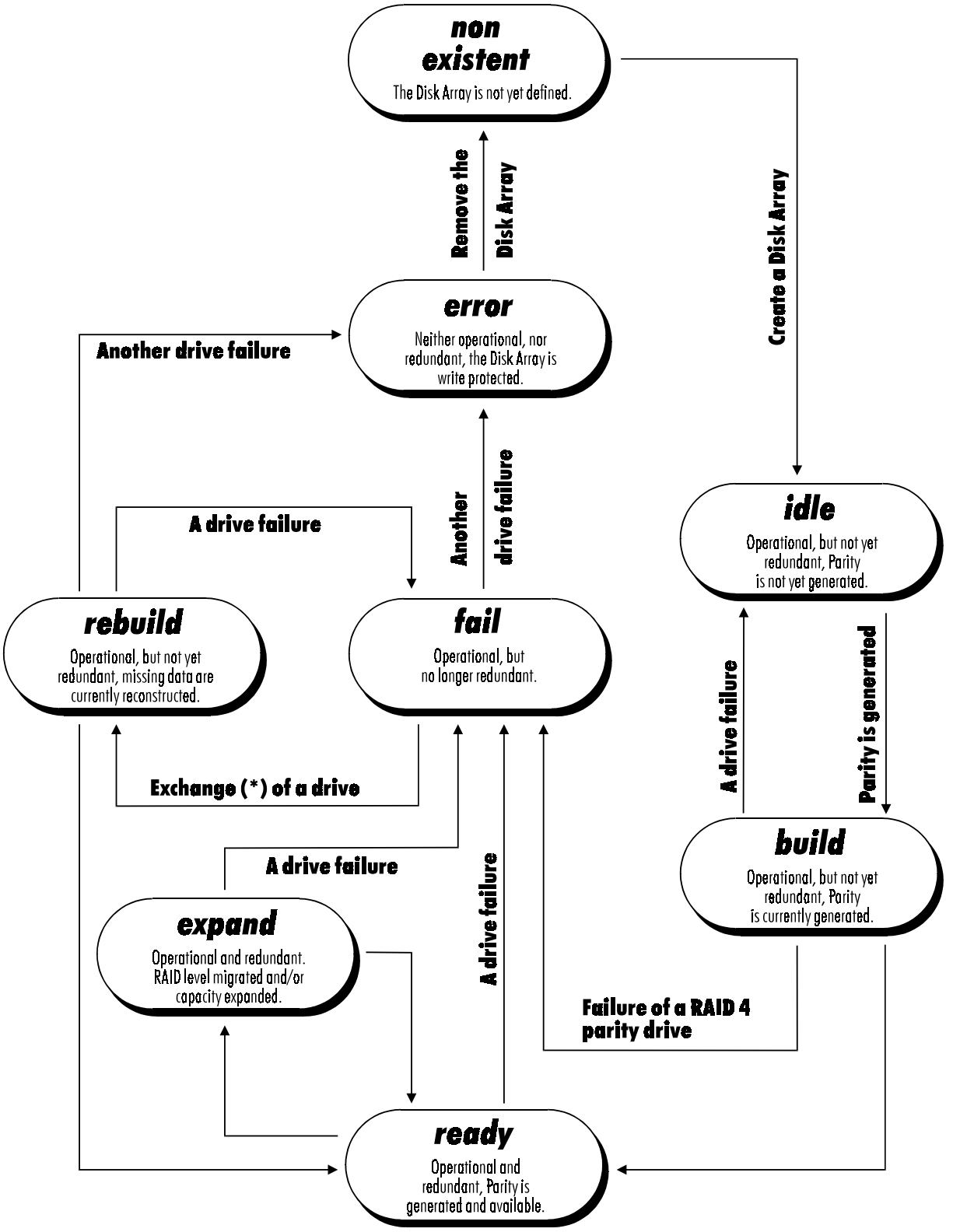
C.11.6 "Expand" State

If the capacity or RAID level of an existing disk array is changed, the disk array changes its state into *expand*. As soon as the expansion or migration is completed, the state changes back to *ready*.

C.11.7 "Error" State

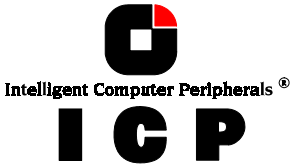
If a second hard disk should fail while the disk array is in the *fail* or *rebuild* state, it is not possible to continue the working session without restrictions. The disk array is still available for I/Os, but data loss and error messages on the host level are possible.
The following state diagram of the disk array summarizes the states described above and the transitions from one state to another.

Some of these states may become the addendum ***patch*** (e.g. *build/patch*, *ready/patch*).
This word indicates that the original Array Drive went through a significant procedure. I.e., the parity information was recalculated anew. Or, the Array Drive has been patched from the error state into the fail state. This may become extremely helpful in a situation where two Logical Drives of an Array Drive, fail at the same time, but only one of the two Logical Drives is really defective and the other was blocked out, since it was connected with the same I/O channel as the defective one. The Array Drive's state is error and normally all data would be lost. RAIDYNE® and GDTSETUP include some functions, which allow the patch of this Array Drive from the error state into the fail sate. Before the actual patch, the defective drive has to be physically removed from the Array Drive. Such a patch-procedure is a real sheet-anchor and should only be used, after a detailed consultation with a trained support person (a printout of the S*ave* I*nformation* file, is extremely helpful).


non existent
The Disk Array is not yet defined.
Remove the Disk Array
Create a Disk Array
error
Neither operational, nor redundant, the Disk Array is write protected.
Another drive failure
Another drive failure
A drive failure
idle
Operational, but not yet redundant, Parity is not yet generated.
rebuild
Operational, but not yet redundant, missing data are currently reconstructed.
fail
Operational, but no longer redundant.
A drive failure
Parity is generated
Exchange (*) of a drive
A drive failure
build
Operational, but not yet redundant, Parity is currently generated.
expand
Operational and redundant. RAID level migrated and/or capacity expanded.
A drive failure
Failure of a RAID 4 parity drive
ready
Operational and redundant, Parity is generated and available.
(*) Replacement either manually, or through hot fix method.

Chapter D

Using MS-DOS



D. Using Microsoft MS-DOS

After having explained the installation of the ICP Controller and the Host Drives in chapters B and C, we now explain how to install the operating system MS-DOS. By using some examples, we shall demonstrate how to partition a host-drive, transfer MS-DOS to the host-drive, install Windows 3.x and use a CDROM drive (standing for any other N*ot* D*irect* A*ccess* D*evice*) under MS-DOS. In addition, we will give you further information on how to install **Windows 95 and Windows 98.** The required ICP disks for DOS and Windows 95/98 can be created from the ICP System CDROM.

D.1 Transparency of Host Drives

The structure of the Host Drives, which have been installed with GDTSETUP (in chapter C), is not known to DOS. i.e., the operating system does not recognize that a given Host Drive consists of a number of hard disks forming a disk array. To DOS this Host Drive simply appears as one single hard disk with the capacity of the disk array. This complete transparency represents the easiest way to operate disk arrays under DOS; neither DOS nor the PCI computer need to be involved in the administration of these complex disk array configurations.

D.2 Partitioning a Host Drive and Transferring MS-DOS

You can partition the Host Drives installed in chapter C with GDTSETUP as well as with the MS-DOS program FDISK. However, in our explanation we shall only use GDTSETUP. For further information on FDISK, please refer to your MS-DOS manual. During the following installation instructions we assume that there is not yet a boot disk in the computer system. Therefore, the following steps aim at installing a *primary* DOS *partition* on the Host Drive previously installed with GDTSETUP (see chapter C), activating this partition, and transferring MS-DOS to this partition. Our objective is to be able to boot MS-DOS directly from this partition at the end of the installation. First of all, we would like to draw your attention to a common operating error which is often made when Host Drives are partitioned. Many users ignore that an MS-DOS boot partition has to have the state **"active"**. If the partition is not active, the system will attempt to boot MS-DOS, but will "hang" straight away. Very often, the system message "ROM BASIC NOT FOUND, SYSTEM HALTED" is displayed (in the 40 lines of text mode). You can easily remedy this problem by booting the system from an MS-DOS floppy disk, and then activating the partition with GDTSETUP (more information later in this manual) or FDISK (for more information on FDISK please refer to the MSDOS user's manual).

(A) As already mentioned before, you can load GDTSETUP in two ways. For the partitioning, GDTSETUP has to be loaded from disk under MS-DOS:

Boot the MS-DOS-operating system (either from a boot-floppy or from an already existing boot drive, i.e., IDE-hard disk etc.).

(B) In order for GDTSETUP to work properly, you have to load the device driver GDTX000 first. This can be done in two ways:

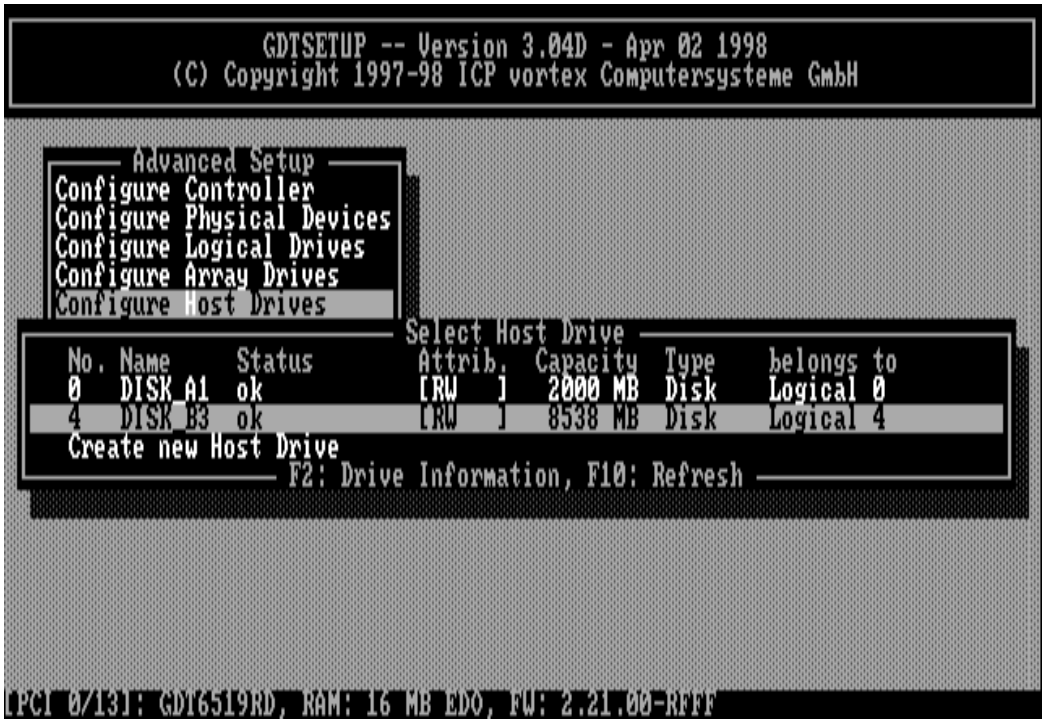
Load GDTX000 from the MS-DOS command level by typing in GDTX000<ENTER>, or load GDTX000 automatically through the CONFIG.SYS file (DEVICE=GDTX000.EXE).

Load GDTSETUP from the MS-DOS command level by typing GDTSETUP<ENTER>.

Note: GDTSETUP.EXE as well as GDTX000.EXE are on the *System Disk* - DOS.

(C) Now, in the program GDTSETUP, select the menu *Configure Host Drives*.

Pressing <ENTER> leads you to the following sub-menu. In our example, the Host Drive list contains two Host Drives. The first drive in the list is not relevant for our example.

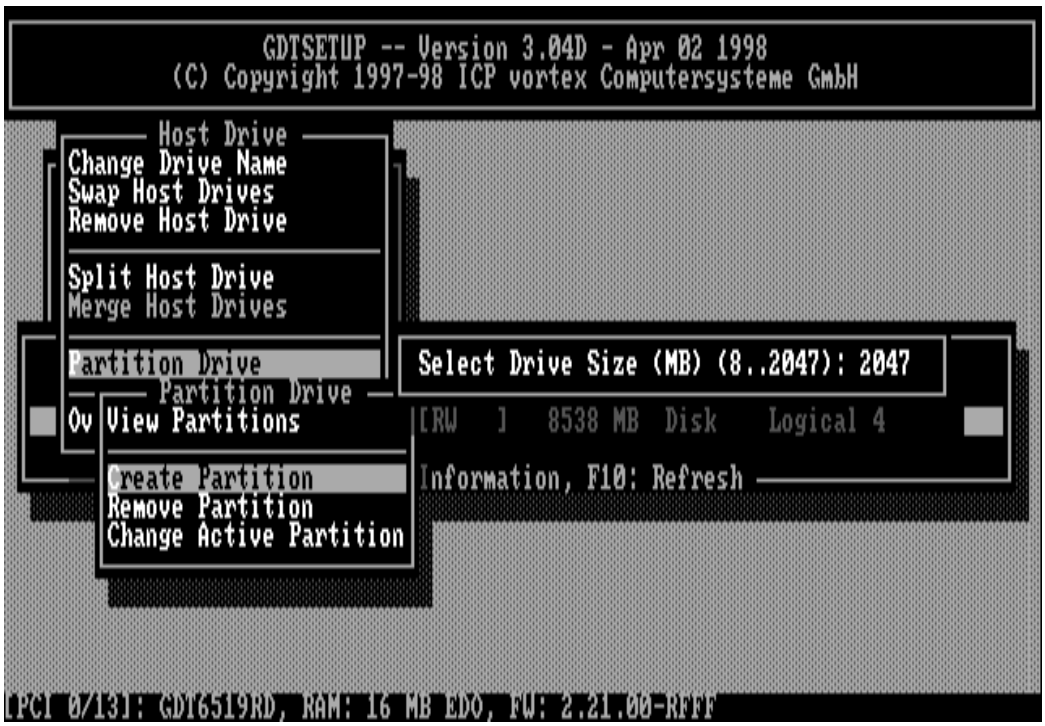


We select this Host Drive (by moving the selection line with the cursor keys ↑ and ↓) and confirm our choice with <ENTER>. Then the following screen comes up:

We now select P*artition* D*rive* and then V*iew* P*artitions*. The following screen appears. In our example, there is no entry yet.

Press <ESC>, select C*reate* P*artition* and press <ENTER>.

In the upcoming window, select P*rimary* P*artition* and confirm with <ENTER>.



Now you can determine the size of the primary partition. In our example, we choose to use 2047MB of the disk capacity for the primary partition and therefore enter 2047 and simply confirm with <ENTER>. Now select *View Partitions* again. You can see that the primary partition has been successfully installed and has the active state (A), which is necessary to boot MS-DOS from this partition.

(D) Now leave GDTSETUP by pressing <ESC>. After a few requests and messages from GDTSETUP, the system reboots.

(E) Now use the MS-DOS program FORMAT to transfer MS-DOS to the primary partition you have just created.
To do so, enter

A:\> FORMAT C: /S <ENTER>

(F) To complete the installation of MS-DOS, use the MS-DOS commands COPY or XCOPY to transfer the desired MS-DOS files.

A different and maybe even more elegant method of installing MS-DOS is to use the SETUP program of MS-DOS versions 5 and 6. In this case, you only have to create and activate a partition with GDTSETUP or FDISK. Then boot the system from the first floppy disk delivered with MS-DOS. MS-DOS SETUP will take care of all the rest.

D.3 CONFIG.SYS and the Driver GDTX000.EXE

GDTX000.EXE is the high performance MS-DOS driver for all ICP Controllers. In order to obtain the best performance of the ICP Controller under MS-DOS, this driver should be listed in the first line following the HIMEM.SYS device command in the CONFIG.SYS file. When loaded, GDTX000.EXE replaces the BIOS EPROM (the so-called INT13H interface) of the ICP Controller, and also offers a VDS (Virtual DMA Services) interface. This is of particular importance for Windows 3.x. When using GDTX000.EXE please observe the following:

- GDTX000.EXE must be loaded from the first line following the HIMEM.SYS device command in the CONFIG.SYS file. If HIMEM.SYS is not loaded, it must be loaded from the very first line of the CONFIG.SYS file.
- GDTX000.EXE can be loaded in the UMA.
- GDTX000.EXE is needed for an optimal use of Windows 3.x.
- The ICP Controller unfolds its full capacity under MS-DOS or Windows 3.x only when GDTX000.EXE is installed.
- In order to load GDTSETUP under MS-DOS from disk, you need GDTX000.EXE.
- In the CONFIG.SYS file, GDTX000.EXE must be loaded before GDTASPI.EXE.

Below is an example of a CONFIG.SYS file which is essential for the MS-DOS configuration

```
device=c:\windows\himem.sys
device=gdtx000.exe
files=30
buffers=30
stacks=9,256
dos=high,umb
install=\dos\keyb.com GR,,\dos\keyboard.sys
device=gdtx000.exe
device=mouse.sys
device=\dos\setver.exe
device=\gdt\gdtaspi.exe
device=\aspi\aswcdnec.sys /D:CDROM
lastdrive=h
```

In this example, besides the GDTX000 driver, the GDTXDOS.EXE driver, the ICP ASPI Manager and an ASPI Module for an NEC CDROM drive are loaded.

D.4 Expanded Memory Managers

When using Expanded Memory Managers, a certain address area has to be excluded from being controlled by these programs. This area is the ICP Dual Ported Memory address space (sized 16KB). If the ICP Controller is not run with the GDTX000.EXE driver (that is, the driver has not been loaded from the CONFIG.SYS file), the address space of the ICP BIOS must also be excluded (the size of the ICP BIOS is 8KB). If the GDTX000.EXE driver is loaded from the CONFIG.SYS file in a line **before** the Expanded Memory Manager (EMM), it is not necessary to exclude the address space of the ICP BIOS. Unlike ISA or EISA computer systems where the controller's BIOS address space is set manually (through jumpers or the configuration file), PCI computers automatically map the address space of a peripheral PCI device (e.g., the ICP Controller with its BIOS and Dual Ported Memory) to a suitable location during a warm or cold boot. If the system configuration does not change (no new PCI expansion cards are being added etc.), the PCI System BIOS will always map these two spaces to the same addresses. To help you find out where these addresses have been mapped to, the ICP BIOS indicates the physical address locations of the ICP BIOS and the ICP DPMEM during the cold boot (also see chapter B in this manual):

BIOS located at 0x000E0000 - 0x000E1FFF
In this example, the ICP BIOS occupies E000:0000 to E000:1FFF (E000 is the segment address).

DPMEM at 0x000D0000 - 0x000D3FFF
Here the DPMEM starts at D000:0000 and ends at D000:3FFF (D000 is the segment address).

You may also use other utility programs such as *Georg Schnurer's* (*c't magazine*) **CTPCI** program in order to obtain the requested address locations. On this occasion we would like to thank Mr. *Georg Schnurer* and the *c't magazine* for allowing us to use this very helpful utility on our system disks.

Example 1: The Microsoft EMM386.EXE Manager is used. The ICP driver GDTX000.EXE has not been loaded from the CONFIG.SYS:

```
DEVICE=EMM386.EXE  X=D000-D3FF X=E000-E1FF
```

Example 2: The Microsoft EMM386.EXE Manager is used. The ICP driver GDTX000.EXE has been loaded from the CONFIG.SYS:

```
DEVICE=EMM386.EXE  X=D000-D3FF
```

(Note: You may have to add the path for "EMM386.EXE". Other parameters may follow the excluded areas).

D.5 Using Windows 3.x

In order to be able to install Windows 3.x, a fully operational MS-DOS operating system has to be present on the chosen partition. Furthermore, the first entry in the CONFIG.SYS file behind the HIMEM.SYS line has to be:

```
DEVICE=GDTX000.EXE
```

(if necessary, add the correct path name after the "=" symbol and before GDTX000.EXE).

(A) Now install Windows according to the instructions given in the Windows manual. Generally, you start with *Disk 1 - Setup* from which you load the setup program. This Setup program guides you through the entire installation and prompts you to insert further floppy disks.

(B) After the installation is completed, the Setup program will ask you if you want to reset the system. This reset must be performed.

(C) If you change to the directory WINDOWS after the reset and type in WIN<ENTER>, Windows will be loaded. Although thanks to its high computing power, the ICP Controller is just right for disk intensive operating systems such as Windows, it will not show its full capacity yet. The reason for this is that the "communication" between Windows and the ICP Controller is not yet carried out by GDTX000.EXE, but by Windows' SMARTDRV driver.

(D) The steps in this section aim at removing SMARTDRV from the CONFIG.SYS and AUTOEXEC.BAT files, and at adding a few entries to the Windows initialization file SYSTEM.INI. Now, delete those lines from the CONFIG.SYS and AUTOEXEC.BAT files which contain SMARTDRV.EXE (one line in each file) using an editor such as EDIT for instance which is part of MS-DOS 5 and 6, or deactivate these lines by entering REM at their beginning. Then save and exit the files. Next, load the SYSTEM.INI file located in the WINDOWS directory into the editor and look for the entry **[386Enh]**. The following lines have to be inserted after this entry:

```
[386Enh]
EMMExclude=D000-D1FF   (or according ICP DPMEM area)
VirtualHDIrq=off
DMABufferSize=128
```

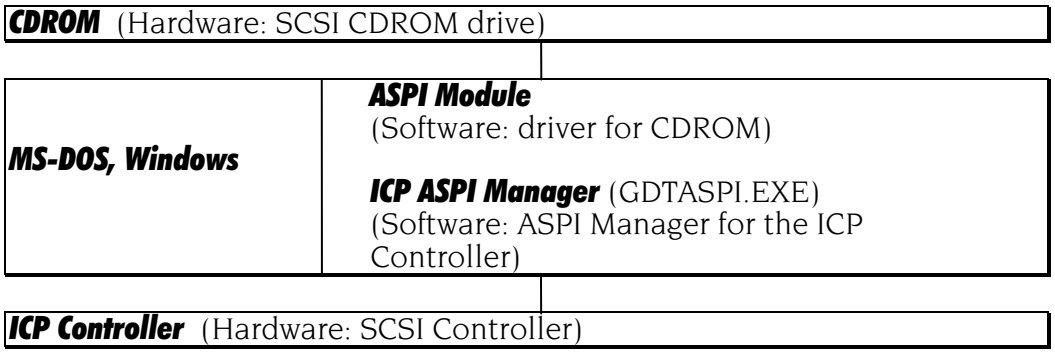
Now save the file. In the line "EMMexclude=..." you have to enter the address area occupied by the ICP DPMEM.

(E) Now do a warm reboot in order for the changes in the CONFIG.SYS the AUTOEXEC.BAT file to take effect.

(F) Now, change to the WINDOWS directory and type in WIN<ENTER>; Windows is loaded again and the installation is completed.

D.6 Using a CDROM Drive under MS-DOS or Windows 3.x

CDROM drives (as well as tape streamers, WORM drives and most MOD drives, too) belong to the category of the so-called ***Not Direct Access Devices***. They **cannot** be installed with GDTSETUP or FDISK and FORMAT and they are not directly supported by MS-DOS or Windows - unlike, for example, hard disks and removable hard disks. To install and access these devices, a special standard, the so-called ASPI Standard (Advanced SCSI programming Interface), has been created. While the manufacturer of the controller (in this case ICP) has to offer the ASPI Manager, the manufacturer of the SCSI device (CDROMs etc.) has to provide an ASPI Module (note: there are some companies which have specialized in the development of ASPI modules, for example Corel Corp. with its product **corelSCSI**; the ICP Controller is certified by Corel). Both units, the SCSI controller and the SCSI device, communicate through this ASPI interface. It is not a hardware interface (like, for example, Centronics, SCSI or RS232), but a pure software interface.
The following illustration explains this interface:



With the following two examples we demonstrate how to install a CDROM drive for use with the ICP Controller under MS-DOS and Windows. The installation differs slightly, depending on whether you use the corelSCSI software or the ASW software. Regardless of which software you choose to use, the ASPI manager of the ICP Controller (located on the ICP *System Disk* - DOS) has to be loaded from the CONFIG.SYS file. The objective of both installations is to make the CDROM drive accessible as a drive (for example drive E) under MS-DOS or Windows, and to be able to access this drive just as if it were a (write-protected) floppy disk in drive A or B.
At this point we presume that the CDROM drive has been properly connected to the ICP Controller. This includes that the SCSI-ID and the SCSI bus terminators are set in accordance with the settings of the already existing SCSI devices (i. e., the SCSI-ID chosen for the CDROM drive is not occupied by another device; resistor terminators are located only at the two ends of the SCSI bus).

D.6.1 Example: Using the ASW Software for the CDROM

The important lines in both files are printed bold.

CONFIG.SYS

```
device=c:\windows\himem.sys
device=gdtx000.exe
files=30
buffers=30
stacks=9,256
dos=high,umb
shell=\COMMAND.COM /E:512 /P
device=\dos\setver.exe
device=\gdt\gdtaspi.exe
device=\aspi\aspicd.sys /D:CDROM
lastdrive=h
```

AUTOEXEC.BAT

```
path=c:\;c:\dos;c:\gdt;c:\aspi;
prompt $P -$G
doskey
c:\aspi\mscdex /D:CDROM
```

The GDTX000.EXE driver is loaded from the first line following the HIMEM.SYS command of the CONFIG.SYS file. Loading the SETVER driver (part of MS-DOS) allows older versions of Microsoft's CDROM translation program MSCDEX (loaded from AUTOEXEC.BAT) to run trouble-free with the MS-DOS version currently installed. The next line loads the ICP ASPI Manager GDTASPI.EXE. Next, the ASPICD module for the CDROM drive is loaded. The pa-

rameter "/D:CDROM" has nothing to do with a drive name, it only serves as a recognition information for MSCDEX. As mentioned before, it is our objective to be able to access the CDROM drive with a drive name (i.e. E). Naturally, this drive name has to be "free", and there have to be enough drive names available. For example, the DOS command LASTDRIVE=H would enable the user to use drive names from A to H. In the AUTOEXEC.BAT file, the Microsoft translation program for CDROMs (MSCDEX - Microsoft CDROM Extension) is loaded. It is not part of MS-DOS (except for version 6). The parameter /D:CDROM set here has to be identical to the parameter set after the ASPICD module in the CONFIG.SYS file. After a warm reboot which serves to activate the changes made in the CONFIG.SYS and AUTOEXEC.BAT files, the CDROM drive can be accessed as drive E (in our example there are two SCSI hard disks in the PCI computer, and under MS-DOS they are accessed as C and D). Drive E can be accessed under Windows, too, now (the Icon next to "E" indicates that it is a CDROM drive).

D.6.2 Example: Using corelSCSI for the CDROM

When using the corelSCSI software, the installation is carried out by a program (*install*) so that the changes in the files CONFIG.SYS and AUTOEXEC.BAT mentioned below are, to a large extent, made automatically. Under corelSCSI the SCSI/FAST-SCSI channels of the ICP Controller are available as independent host adapters. The important lines in both files are printed bold.

CONFIG.SYS

```
device=c:\windows\himem.sys
device=gdtx000.exe
files=30
buffers=30
stacks=9,256
dos=high,umb
shell=\COMMAND.COM /E:512 /P
device=\dos\setver.exe
device=\gdt\gdtaspi.exe
device=c:\corel\cuni_asp.sys /ID:6 /HAN:0 /N:1 /D:MSCD000
lastdrive=h
```

AUTOEXEC.BAT

```
path=c:\;c:\dos;c:\gdt;c:\aspi;
prompt $P -$G
c:\corel\corelcdx /M:8 /D:MSCD000
```

The first line following the HIMEM.SYS command of the CONFIG.SYS file loads the GDTX000.EXE. The next line loads the ICP ASPI Manager GDTASPI.EXE. Next, the corel ASPI Module for the CDROM drive is loaded. The parameter "/D:MSCD000" has nothing to do with a drive name, it only serves as recognition information for CORELCDX. As mentioned before, it is our objective to be able to access the CDROM drive with a drive name (i.e., E). Naturally, this drive name has to be "free", and there has to be enough drive names available. For example, the command LASTDRIVE=H would enable the user to use drive names from A to H under DOS. In the AUTOEXEC.BAT file, the corel translation program for CDROMs, CORELCDX, is loaded. The parameter /D:MSCD000 set here has to be identical to the parameter set after the ASPI Module in the CONFIG.SYS file. After a warm reboot which serves to activate the changes made in the CONFIG.SYS and AUTOEXEC.BAT files, the CDROM drive can be accessed as drive E (in our example there are two SCSI hard disks in the PCI computer, and under MS-DOS they are accessed as C and D). Drive E can be accessed under Windows, too, now (the Icon next to "E" indicates that it is a CDROM drive).

Information on the various CDROM drives which can be used can be obtained directly from Corel.

D.7 The ICP ASPI Manager GDTASPI.EXE

The ICP ASPI Manager GDTASPI.EXE allows you not only to run N*ot* D*irect Access Devices* (e.g., CDROMs, tapes, MODs etc.), but to control hard disks and removable hard disks, too (the so-called D*irect Access Devices*). These devices are then no longer controlled by GDTSETUP but exclusively by the ASPI interface. The advantage is evident, in particular with regard to removable hard disks. When using an appropriate ASPI module to access these removable hard disks, for example ASPIDISK.SYS or UNI_ASP.SYS from Corel, you can exchange the media of these drives under DOS without having to use GDTSETUP. To the ASPI interface, the ICP Controller appears as one host-adapter. If there are more SCSI controllers (even if from various manufacturers) in the system and corresponding ASPI managers have been installed in the CONFIG.SYS file, you can determine a controller's host adapter number by using the ICP program **ASPISCAN.EXE**. In order to exclude that a D*irect Access Device* is run directly from the ICP Controller, it has to be reserved for the ASPI interface control. To do so, certain parameters have to be specified when the ICP ASPI manager is loaded:

DEVICE=GDTASPI.EXE /R:Hx1Iy1[:Hx2Iy2:Hx3Iy3 ...]

H:	host adapter number
I:	SCSI ID of the SCSI device to be reserved
x1, y1:	host adapter number, SCSI ID of the first SCSI device to be reserved (in decimal form)
x2, y2:	host adapter number, SCSI ID of the second SCSI device to be reserved (in decimal form)

Example: We assume that there is only one ICP Controller in the system. Two *direct access devices*, the removable hard disk connected to channel A, ID 2, and the hard disk connected to channel B, ID 4, have to be reserved for the ASPI manager. The corresponding entry in the CONFIG.SYS is:

DEVICE=GDTASPI.EXE /R:H0I2:H1I4

Important note: SCSI devices reserved for the ASPI manager must not have been initialized with GDTSETUP. Neither must they pertain to an ICP Logical or Host Drive. If necessary, these devices can be de-initialized with GDTSETUP.
As already mentioned in paragraph 6 of this chapter, in addition to the ASPI manager an ASPI module has to be present in order to be able to access the SCSI device under MS-DOS with a drive name (e.g., D, E, etc.). In the following description you find how to install ASPI interface-reserved *direct access devices* with the ASW ASPI module ASPIDISK.SYS and the corelSCSI ASPI module UNI_ASP.SYS.

D.7.1 Using ASW ASPIDISK.SYS

***Step* 1:** Include GDTX0000.EXE, GDTASPI.EXE with appropriate reservations (../R:..), and ASPIDISK.SYS in the CONFIG.SYS file, then do a warm reboot (Ctrl+Alt+Del).
***Step* 2:** Use the ASW program AFDISK.EXE to initialize the drive to be run through the ASPI interface.
Step 3: After the successful initialization, do a warm reboot (Ctrl+Alt+Del).
The CONFIG.SYS will be similar to the following (the relevant entries are printed bold):

device=gdtx000.exe
files=30

```
buffers=30
stacks=9,256
shell=\COMMAND.COM /E:512 /P
device=\gdt\gdtxdos.exe
device=\gdt\gdtaspi.exe /R:H114
device=aspidisk.sys
```

Note: Drives run with ASPIDISK.SYS are not compatible with drives run with GDTSETUP.

D.7.2 Using corelSCSI

***Step* 1:** Include GDTX0000.EXE, GDTASPI.EXE with appropriate reservations (../R:...) in the CONFIG.SYS file, then do a warm reboot (Ctrl+Alt+Del).
***Step* 2:** Load corel's I*nstall* program and follow the instructions. Preferably, use E*xpress-Setup*.
***Step* 3:** After the successful installation, do a warm reboot (Ctrl+Alt+Del).
***Step* 4:** Using the corelSCSI program CFORMAT, format the drive to be run through the ASPI interface.

The CONFIG.SYS will be similar to the file below (the relevant entries are printed bold). The parameters following the corelSCSI driver refer to a particular configuration, they have automatically been added by the corelSCSI INSTALL program.

```
device=gdtx000.exe
files=30
buffers=30
stacks=9,256
shell=\COMMAND.COM /E:512 /P
device=\gdt\gdtxdos.exe
device=\gdt\gdtaspi.exe /R:H114
device=\coreldrv\UNI_ASP.SYS /C:4 /ID:4;;;1 /VOL:1 /DOS4 /SS:512 /@4:-98
```

Note: Drives run with corelSCSI and the UNI_ASP.SYS driver are neither compatible with drives run with GDTSETUP and the ICP cache nor with those run with the above mentioned ASPIDISK.SYS driver.

D.8 Installing Windows 95

This guide will take you through the process to install the files necessary to allow the controller to operate under Windows 95.
We differentiate three cases: The ICP Controller is the primary controller, the ICP Controller is the secondary controller, and the ICP Controller is already installed under Windows 95 and its driver should be updated.

D.8.1 The ICP Controller is the primary controller

You must create an **MS-DOS partition** on and **format** the drive to which Windows 95 is to be installed. You also need a **CDROM** that is fully accessible under MS-DOS.

1. Transfer the WIN95 files from the **ICP System CDROM** to a 3.5" floppy disk. The files are located in the directory, (your CDROM drive letter):\DRIVERS\WIN95. You will need this disk later in the Windows 95 Setup.

2. Power-on the system. Press **Ctrl+G** to enter the **GDTSETUP** program.

3. Select the controller - **<ENTER>**. Press **F2** to enter **Advanced Setup**.

4. Highlight **Configure Controller** - **<ENTER>**. Highlight **Controller Settings** - **<ENTER>**.

5. Highlight **Delayed Write** - **<ENTER>**. Highlight **OFF** - **<ENTER>**. Delayed write is now disabled. This is done to ensure all files are written immediately to the Host Drive during the Windows installation.

6. Press **Esc**. A message appears: "Do you want to save changes?" Press **<Y>**.

7. Install Windows 95 per instructions provided with the program.

8. After installation: double click **My Computer** icon. Double click the **Control Panel** icon.

9. Double click the **System** icon. Click the **Device Manager** tab.

10. Double click **Other Devices**. Double click **PCI SCSI Bus Controller**.

11. Click **Driver**. Click **Change Driver**. Double click **SCSI Controllers**.

12. Click **Have Disk**. Insert the ICP Windows 95 driver disk you created in step 1.

13. Click **OK**. Click **OK** again. Click **OK** again.

14. Click **Cancel**. **Never click Test. Windows 95 is unable to determine if the ICP BIOS can be removed. Using the Test option may cause the system to freeze.**

15. **Remove** the ICP Windows 95 driver disk. Restart the system.

Upon completion of the Windows 95 installation you will need to load the GDTMON program to Windows 95. The following steps will take you through this process.

1. Find the GDTMON.EXE file in the DRIVERS\WIN95 directory on the ICP System CD.
2. Copy GDTMON.EXE to your Host Drive. Start the GDTMON program.
3. Press **<ENTER>** to select the Controller. Press **<ENTER>** to select the Protocol.
4. Press **<ENTER>** to select the Controller installed.
5. Highlight **View/Change Settings** and press **<ENTER>**.
6. Highlight **Cache Settings** and press **<ENTER>**.
7. Highlight **Delayed Write**. Use the space bar to toggle setting to **ON**.
8. Press **<ENTER>** two times. Delayed Write is now enabled.
9. Highlight **Save Information** and press **<ENTER>**.
10. Type the file name **ICP001** and press **<ENTER>**. *NOTE: This creates a "snapshot" of your system configuration. Anytime the configuration changes (i.e. add a new hard drive, hard drive failure, change system parameters, etc.) save the information again, using the ICP header for the file and the next higher number (i.e. ICP001, ICP002, ICP003, etc.). This information will be needed by ICP Technical Support personnel to assist you in troubleshooting problems with the controller.
11. Press **Esc** two times to exit the GDTMON program.

D.8.2 The ICP Controller is the secondary controller

1. Transfer the WIN95 files from the **ICP System CD** to a 3.5" floppy disk. The files are located in the directory, (your CDROM drive letter):\DRIVERS\WIN95. You will need this disk later in the Windows 95 Setup.
2. In Windows 95 double click on **My Computer** icon. Double click **Control Panel** icon.
3. Double click the **System** icon. Click the **Device Manager** tab.
4. Double click **Other Devices**. Double click **PCI SCSI Bus Controller**.
5. Click **Driver**. Click **Change Driver**. Double click **SCSI Controllers**.
6. Click **Have Disk**. Insert the ICP Windows 95 driver disk you created in step 1.
7. Click **OK**. Click **OK** again. Click **OK** again.
8. Click **Cancel**. **Never click Test. Windows 95 is unable to determine if the ICP BIOS can be removed. Using the Test option may cause the system to freeze.**
12. Remove the ICP Windows 95 driver disk. Restart the system.

D.8.3 Update the ICP Windows 95 Driver

1. Download the **WIN95.EXE** file from the ICP web site (http://www.icp-vortex.com). This self-extracting file contains all the Windows 95 files you need.
2. Run **WIN95.EXE** to get the update files.
3. Format a 3.5" HD disk (1.44MB). **Copy** all Windows 95 files to this disk.
4. In Windows 95 double click on **My Computer** icon. Double click **Control Panel**.
5. Double click **System** icon. Click **Device Manager** tab.
6. Double click **SCSI controller** icon. Double click the **ICP Controller** shown.
7. Click **Driver** tab. Click **Change Driver**.
8. Click **Have Disk**. Insert the Windows 95 driver disk created in step 3.
9. Click **OK** until you reach a prompt to specify the location of the update files.
10. Select the drive where the update disk is located. Click **OK**.
11. When file copy is done, remove the update disk and click Yes.
12. After installation of the new driver, the system needs to **reboot** before the new settings will take effect.

D.9 Installing Windows 98

The Mini Port Driver for Windows 95 which is delivered on the ICP System CDROM can be also used for Windows 98. If Windows 98 is installed via a CDROM which is connected with the ICP Controller, the following installation instructions have to be observed:

Step 1: *Preparation of the installation*
The "Delayed Write" function has to be switched off via the GDTSETUP program in the ROM of the ICP Controller. As soon as the Windows 95/98 driver of the ICP Controller is installed, this function can be switched on again. The driver checks whether the data in the cache of the controller is being written to the hard disks (so-called cache-flush).

Step 2: *Installation via a hard disk partition.*
It is recommended to transfer the installation data from the Windows 98 CDROM onto a hard disk partition beforehand. Therefore, the access to the CDROM connected with the ICP Controller has to be configured on the boot disk delivered with Windows 98. It is recommended to make a copy of the Windows 98 boot disk first and then to install the corresponding files from the ICP CDROM (see this chapter), in order to setup the access to the CDROM drive under DOS.

With this modified boot disk, a partition can be installed on the desired host drive (e.g., a single hard disk or a RAID array) of the ICP Controller. All data from the Win98 directory of the Windows 98 CD has to be transferred to a corresponding directory on the host drive by using the command "xcopy". In addition, the setup.exe file has to be copied from the root directory of the Windows 98 CD onto the host drive. If not yet available, it is now also time to generate an ICP Windows 95/98 driver disk from the ICP System CDROM.

***The Windows 98 boot disk is modified once again by removing all drivers for the* ICP Controllers.** The Setup Program from Windows 98 can be started after booting from the boot disk in the previously created partition of the host drive.

The installation of Windows 98 can then be carried out in the usual way. After the installation has been carried out, the driver for the ICP Controller is installed (just as in Windows 95) via the device manager (also see this chapter).

Chapter E

Using NetWare

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E. Using Novell NetWare

After having explained in chapters B and C the installation of the ICP Controller and the Host Drives, we would now like to give you some hints and pieces of advice on how to install Novell's operating system Novell NetWare. We shall mainly focus on NetWare 3.x, NetWare 4.x and NetWare 5. For successful installation, it is essential to study the NetWare system manuals thoroughly. The information given in this chapter refers to the loading of the ICP NetWare driver(s) only.

E.1 Transparency of Host Drives

The structure of the Host Drives, which have been installed with GDTSETUP (in chapter C), is not known to NetWare. I.e., the operating system does not recognize that a given Host Drive consists of a number of hard disks forming a disk array. To NetWare, this Host Drive simply appears as one single hard disk with the capacity of the disk array. This complete transparency represents the easiest way to operate disk arrays under NetWare; neither NetWare nor the PCI computer need to be involved in the administration of these complex disk array configurations.

E.2 Novell NetWare 3.10, 3.1, 3.12 and 3.20

The ICP Controller and the Host Drives previously configured with GDTSETUP are integrated by means of the ICP driver software located on the ICP System CDROM. The driver belongs to the category of so-called NLMs (NetWare Loadable Module).

GDTRP310.DSK	for NetWare 3.10
GDTRP311.DSK	for NetWare 3.11
GDTRP312.DSK	for NetWare 3.12 and 3.20
ASPITRAN.DSK	ASPI manager
CTRLTRAN.DSK	Module for GDTMON

(Note: More information about the GDTMON diagnosis tool can be found in a separate chapter of this manual.). The installation of the fileserver itself is carried out following the Novell NetWare documentation. According to your NetWare version, copy the appropriate driver, the ICP ASPI Layer ASPITRAN.DSK and the ICP CTRLTRAN.DSK module to the boot disk or the DOS boot partition. During installation type in,

:LOAD GDTRP310 <ENTER>	(NetWare 3.10)	or
:LOAD GDTRP311 <ENTER>	(NetWare 3.11)	or
:LOAD GDTRP312 <ENTER>	(NetWare 3.12, 3.20)	

The ICP ASPI Manager ASPITRAN.DSK and the CTRLTRAN.DSK module will then be automatically loaded by the ICP NetWare driver (GDTRP310, GDTRP311 or GDTRP312). If more ICP Controllers are installed in the fileserver (i.e., for controller duplexing), the above mentioned driver has to be loaded several times. But as it is re-entrant, it is only loaded once. A single ICP Controller can be chosen by selecting its PCI slot number.

E.3 Novell NetWare 4.x – Using "DSK" Driver

The ICP Controller and the Host Drives previously configured with GDTSETUP are integrated by means of the ICP driver software located on the ÎCP System CDROM. The driver belongs to the category of the so-called NLMs (NetWare Loadable Module).

GDTRP400.DSK	for NetWare 4.x
ASPITRAN.DSK	ASPI manager
CTRLTRAN.DSK	Module for GDTMON

(Note: More information about the GDTMON diagnosis tool may be found in a separate chapter in this manual.)

if you wish to install NetWare 4.x from a CDROM, you first have to set up the CDROM drive under MS-DOS, following the instructions given in chapter D, section D.6. Then install NetWare following the instructions in the NetWare documentation. During the installation, the NetWare installation program asks you which hard disk driver you want to load, showing a list of available drivers. As the ICP driver is not part of this list yet, you have to boot it from the floppy disk: insert the ICP N*ovell* N*etWare* disk into the floppy drive. Now, select the drivers GDTRP400, ASPITRAN and CTRLTRAN. Complete the installation according to the instructions given by the NetWare installation program.
Naturally you can also load the ICP driver directly from the system console, just as with NetWare 3.x:

:LOAD GDTRP400 <ENTER>

(ASPITRAN.DSK and CTRLTRAN.DSK will be loaded automatically). If more ICP Controllers are installed in the fileserver (i.e., for controller duplexing), the above mentioned driver has to be loaded several times. But as it is re-entrant, it is only loaded once. A single ICP Controller can be chosen by selecting its PCI slot number.

E.4 Novell NetWare 4.x – Using "HAM" Driver

ICP Controllers also support the HAM (Host Adapter Module) specification.

Before installing the ICP HAM driver make sure that your NetWare operating system is upgraded to the last level (Service Pack or Patches). To download the latest patches check the Novell website www.novell.com.

The ICP HAM driver for all ICP Controllers using Intel's i960Rx CPUs is:

GDTRP103.HAM - the HAM driver
GDTRP103.DDI - installation file for GDTRP103.HAM

This ICP HAM driver supports all NetWare versions where the latest NWPA (NetWare Peripheral Architecture) support modules are available and installed. (Note: there is a NWPA.EXE file on the ICP System CDROM which includes amongst others various CDMs - Custom Device Modules. Before you install these modules make sure that you do not overwrite already existing newer modules.)

Update a NetWare *4.x system from* ICP DSK *to* ICP HAM *driver support*

To upgrade a pre-installed server from DSK- to HAM-drivers, the following steps should be carried out:

- Copy the file NWPA_411.EXE to the server start-directory and start it there. The file is self-extracting and can be deleted after use (see above note).
- Copy GDTRP103.HAM and CTRLTRAN.HAM into the server start-directory.

- Change all command lines in STARTUP.NCF and in AUTOEXEC.NCF from DSK to HAM. If CTRLTRAN.DSK is loaded directly, this command line must also be changed (CTRLTRAN.HAM). If the DSK driver is replaced by the HAM driver, the slot number parameter has to be changed as well.

- ASPITRAN.DSK is not required any more and can be deleted. NWASPI.CMD is used instead (part of NWPA_411.EXE). This ASPI driver has to be loaded if you want to use ASPI devices.

New Installation of NetWare 4.*x with* ICP HAM *driver support*

For a new installation with the ICP HAM driver the following steps are required:

- Create a temporary directory on the boot drive (e.g., C:\NWPA).

- Copy the file NWPA_411.EXE to the temporary directory C:\NWPA and start it there. The file is self-extracting and can be deleted after use (see note on previous side)

- Start the NetWare server installation.

- If the message "Install found the following hardware but was unable to find a matching driver" appears, switch to the file server console with (<ALT>-<Esc>).

- Type "SEARCH ADD 1 C:\NWPA" at the file server console.

- Type "LOAD C:\NWPA\NWPALOAD" at the file server console.

- Return to the installation screen (<ALT>-<Esc>).

- Press <RETURN> to get a list of all available drivers.

- Press <INSERT> to select additional drivers.

- Insert a prepared floppy disk with the ICP HAM driver (and DDI file) into the floppy drive and press <RETURN>. After reading the floppy disk information a new list appears.

- Select the ICP HAM driver now.

- The installation process asks now for the slot number of the ICP Controller. To determine this number, the following steps should be carried out:

  Switch to the file server console with <Alt>-<ESC>.

  Type "LOAD GDTRP103.HAM".

  The driver now determines the slot number(s) and displays all slot numbers of all ICP Controllers. They should be written down.

  Press <ESC> to stop the driver loading procedure.

  Return to the installation screen (<ALT>-<Esc>).

- Now insert the slot number of the ICP Controller. If there are additional ICP Controllers in the system, load a driver for each of them with a unique slot number. Do not use the same slot number for more than one ICP Controller.

- Continue with the server installation.
- 'Down' and 'Exit' the server at the end of the installation.
- Copy all files except NWPA_411.EXE from the temporary directory to the start-directory of the server. The temporary directory can be deleted afterwards.

E.5 Tips and Tricks

E.5.1 Optimize Data Throughput

High performance RAID controllers are designed for multi-I/O operations and are capable of processing several I/Os simultaneously. Especially cache controllers with powerful on-board RISC CPUs can handle many I/Os per second. NetWare offers the option of adjusting the number of write I/Os which are loaded on the mass storage subsystem. In order to gain optimum performance and speed from modern high performance disk controllers, the amount of the so-called 'maximum concurrent disk cache writes' has been increased with every further development of NetWare. Looking back to NetWare 3.11, only 100 'concurrent disk cache writes' were possible. With NetWare 4.10, this can be as much as 1000.
The number of concurrent disk cache writes delivering the best performance is highly dependent on the performance of the installed disk controller, the amount of cache RAM on the controller and the hard disks. The ICP Controllers can easily cope with up to 500 simultaneous requests. The following command line enables the adjustment of a new number under NetWare (default value = 50):

set maximum concurrent disk cache writes = xxxx

where xxxx represents the required number of concurrent disk cache writes.

E.5.2 'cache memory allocator out of available memory' in PCI-ISA Sy s-tems

PCI-Systems which are not equipped with an EISA-Bus behave in the same way as an ISA mainboard with regard to the available RAM memory. NetWare therefore does not automatically recognize the available memory above 16 MByte. The command 'Register Memory' allows the registration of memory above 16 MByte.
Memory shortage can appear while loading several applications simultaneously on the server, especially where large volumes are concerned. This is because the Register Memory Command is normally carried out in the autoexec.ncf file. This is usually located in the SYS-Volume.
An autoexec.ncf file placed in the DOS-Partition of the NetWare Server helps to get around this problem. In order to carry out this process, the disk driver has to be removed from the startup.ncf and inserted into the autoexec.ncf in the DOS partition. In this case, the disk driver has to be loaded directly after the Register Memory command. An example of an autoexec.ncf file:

register memory 1000000 1000000
LOAD C:GDTRP312
....
In addition, a further start file can be loaded on the SYS volume for differentiation, e.g., with the name 'autonet.ncf'.

E.5.3 Installing NetWare 4.1 - Wrong Drive Name

The following problem often occurs when installing NetWare 4.1 server: While copying the module cdrom.nlm the system hangs - forever. This problem only occurs when the CDROM drive's name under MS-DOS is 'cdrom', i.e., the config.sys/autoexec.bat contains the following files:

DEVICE=aspicd.sys /D:cdrom
and
mscdex /D:cdrom

To avoid this problem, simply change the CDROM's name in DOS to another name, i.e., use '/D:scsicd' instead of '/D:cdrom'.

E.5.4 NetWare-Server Not Stable When High Utilization

High server utilization, combined with a large number of applications running on the server often leads to the following problem: The number of 'Dirty Cache Buffers' increases tremendously and the server is then not stable. In order to avoid this situation, the following parameters should be modified:

1. Increase the number of concurrent disk cache writes for the disk subsystem:

set maximum concurrent disk cache writes

This parameter can be increased up to 500 for high performance controllers and fast hard disks.

2. Decrease the delayed write standard parameter:

set dirty disk cache delay time

This parameter sets the time whereafter 'dirty buffers' are written (flushed) from the cache of NetWare to the hard disk. The minimum value is 0.8 seconds which influences the server performance substantially. Therefore, care should be taken not to go below 0.8 seconds.

E.5.5 ICP Controller and Non-ASPI Compatible Controllers

If an ICP Controller is operated under NetWare together with a further controller / host adapter which does not support the ASPI standard, SCSI Raw Devices cannot be operated on both controllers (tapes, CDROMs).
In general, NetWare gives preference to controllers which support the ASPI Standard (e.g.: ICP, Adaptec). As soon as ASPITRAN.DSK is loaded (Auto-Loading Module) tapes and CDROMs on the ASPI non-compatible controller are no longer recognized.
To avoid this problem, the file ASPITRAN.DSK can be deactivated via a modification.
Please note: After this modification, no other Raw Devices (tapes, CDROMs) are recognized on the ICP (Adaptec,...).
In order to deactivate ASPITRAN.DSK, the string 'ASPI_Entry' has to be found by using a Disk-Monitor in ASPITRAN.DSK (please pay attention to capitals etc). This string is then modified, e.g., by replacing 'A' with an 'X' (i.e., 'XSPI_Entry').
This modified ASPITRAN.DSK enables the operation of Raw Devices on the non-ASPI-compatible Controllers.

E.5.6 Last Status Information

All ICP Controllers temporarily store the status information from all hard disks which are connected. This information can be very useful when searching for possible causes of disk failures or interferences. The last status information consists of a hexadecimal, 8 digit number and can be displayed via the GDTMONitor or can be saved in a SAVE INFORMATION ASCII file. The information is temporarily available in the ICP Controller's RAM. Therefore, it is important to check this information before switching off and before carrying out a Reset if a disk failure has occurred, or if interference was present. The last status information is divided into Controller-specific and SCSI-specific messages. A detailed description can be found in the files LASTSTAT.PDF (Adobe Acrobat format) or LASTSTAT.TXT (ASCII format) on the ICP vortex Website (http://www.icp-vortex.com).

E.5.7 Adding Additional Capacity After An Online Capacity Expansion

The additional capacity resulting from an online capacity expansion of an existing Array Drive is introduced to the system as a new Host Drive. In order to be able to make use of the new capacity without having to down the server, type "*scan for new devices*" on the server console to recognize the new capacity. Use I*nstall* to build new partitions and volumes.

E.6 Notes on ARCserve

Please make sure that you always have the latest version of your ARCserve software.
The back-up program ARCserve can be used in connection with the ICP Controller. The communication between the tape device (for example DAT, DLT) and the ICP Controller takes place through the ASPI interface. For this purpose, the ICP ASPI Manager ASPITRAN.DSK is needed. When loading the regular ICP NetWare driver (for example GDTRP311.DSK), the ASPI Manager is automatically loaded, too. During the installation of ARCserve, choose ***Adaptec ASPI Manager*** as interface.

Chapter F

Using Windows NT

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ICP

F. Using Microsoft Windows NT

After having explained the installation of the ICP Controller and the host drives in chapters B and C, we now explain how to install the operating system Microsoft Windows NT.
For a successful installation, we recommend that you take a close look at the manuals which came with your Windows NT package.

F.1 Transparency of Host Drives

The structure of the Host Drives, which have been installed with GDTSETUP (in chapter C), is not known to Windows NT. I.e., the operating system does not recognize that a given Host Drive consists of a number of hard disks forming a disk array. To Windows NT, this Host Drive simply appears as one single hard disk with the capacity of the disk array. This complete transparency represents the easiest way to operate disk arrays under Windows NT; neither Windows NT nor the PCI computer need to be involved in the administration of these complex disk array configurations.

F.2 General Information on Windows NT

Your ICP Controller may be operated in all operating system variants, the Windows NT ***Workstation*** variant, the Windows NT ***Small Business Server*** variant and the Windows NT ***Enterprise Edition*** variant. The ICP Controller is integrated into the Windows NT operating system through the GDTX.SYS driver which is the same for all Windows NT variants.

For some ICP Controllers there is a special and optional firmware available (Cluster RAIDYNE), which allows the setup and operation of ***Microsoft Cluster Server*** (MSCS).
For further information on ICP clustering, check our website or contact us directly.

F.3 Preparing the Installation

The following steps have to be carried out and/or checked before you can begin with the installation of Windows NT.

Step 1 - Create an ICP Windows NT driver disk.
You need a 3.5" HD formatted floppy disk. Create from the ICP System CDROM the ICP Windows NT driver disk (you can copy file by file or write an image). If you copy file by file ***do not use the Explorer***, because it may not copy all files from the ICP System CDROM.
If you intend to install Windows NT 3.50 on your system, please observe the following: The ICP driver for NT 3.50 is located in the subdirectory DRIVERS of the ICP Windows NT driver disk. Its name is GDTX350.SYS. This file has to be renamed into GDTX.SYS and copied into the root-directory of the ICP Windows NT driver disk.

Step 2 – Disable the Delayed Write Cache of the ICP Controller during the NT installation.
When you do a warm boot by simultaneously pressing the CTRL+ALT+DEL keys, some PCI motherboards carry out a hard reset of the PCI bus. As a consequence, all expansion cards and devices that are connected to the PCI bus, including the ICP Controller, are reset. During the installation procedure of Windows NT this anomaly can cause the contents of the ICP cache RAM to be deleted before the data can be written to the disk(s). If this happens, the installation cannot be completed correctly. Such a warm boot automatically takes place after a FAT partition is converted into an NTFS partition at the end of the Windows NT installation procedure. In order to avoid this problem and prevent the risk of data corruption, **the D*elayed* W*rite* function of the ICP cache must be disabled during the complete in-**

stallation. To do so, use the GDTSETUP program, choose *Advanced Setup*, *Configure Controller*, *Controller Settings* and switch the *Delayed Write* function OFF. After having completed the Windows NT installation, switch the Delayed Write function ON again.

Step 3 – The partition size of the NT boot partition.
The size of a Windows NT boot partition is limited to a maximum capacity of 4GB (this is a Windows NT restriction).

Step 4 – Check the Master Boot Record.
In some cases Windows NT checks the virtual geometric parameters (heads, sectors) of the ICP Controller BIOS Host Drives during the installation process. This can cause Windows NT to calculate wrong parameters. In this case, the first part of the installation procedure (text mode) seems to work fine, but after the first warm boot the installation terminates irregularly because the Windows NT boot loader is no longer available.
To avoid this problem (which will inevitably occur with Host Drives larger than or equal to 1GB), we recommend that you first re-create the so-called *master boot record* (MBR) of the given Host Drive, and secondly, to prepare the Host Drive with a little program named NTPREP for the Windows NT installation. NTPREP.EXE is part of the ICP Windows NT driver disk.

FDISK /MBR <ENTER> and NTPREP <ENTER>

GDTSETUP includes an option that makes both, FDISK /MBR and NTPREP.
Select the *Configure Host Drives* menu and then *Overwr. Master Boot Code*.

You should never use *Overwr. Master Boot Code* or FDISK /MBR and NTRPEP when the Host Drives already contain valid data.

Step 5 – Check the SCSI-IDs for proper setting.
When connecting the various SCSI devices to a SCSI channel of the ICP Controller, please ensure that the SCSI-ID of all N*ot-Direct-Access* devices (e.g., CDROM, DAT-Streamer, MO-drive, etc.) are adjusted to a value greater than or equal to 2. This applies also for the CDROM drive from which Windows NT is installed.

Step 6 – Check the boot priority of your system.
Make sure that the boot priority in the BIOS setup of your system is "A,C, ..".

F.4 The Installation

First of all, make sure that you have verified or carried out all steps described in section F.3.

F.4.1 The ICP Controller is the only Controller in the System

The following instructions 1.) to 12.) assume that the ICP Controller is the only controller in the system and that the operating system is booted from its first Host Drive.

We highly recommend you to install Windows NT with the three floppy disks which came with your Windows NT software package and *not to use* any other installation method.

It is very easy to create a new set (three HD floppy disks) of Windows NT installations disks with

winnt /ox <ENTER>
(for MS-DOS and the MS-DOS mode of Windows95/98), or

winnt32 /ox <ENTER>
(for a Windows95/98 32 Bit environment or Windows NT)

Both programs (winnt.exe and winnt32.exe) are in the i386 directory of the Windows NT CD.

***Important note for the installation of the* Small Business Server (SBS):**
The original installation disks contained in the original SBS package, are not suitable for installations with hard disk controllers other than already on the installation disks.
Thus, you cannot use the original installation disks. In order to obtain suitable disks, follow these two steps:
(A) Create a new set with loading "Winnt /OX" from the i386 directory of the SBS CDROM No.1. Do not execute this command in a DOS-window, but only under a normal DOS; otherwise the /OX switch is ignored. You need three new formatted 3.5" HD floppy disk.
(B) After finishing the creation of the three new installation disks, copy the WINNT.SIF file from the SBS CDROM No.1 onto "Installation Disk 2". The file is also located in the i386 directory.

1. Insert the first Windows NT setup disk (Disk #1) into the boot floppy disk drive and reset the system. After a while you are asked to insert Disk #2.
2. Select: ***S=Skip Detection***
3. Select: ***S=Specify Additional Device***
4. Choose ***Other (Requires disk provided by hardware manufacturer)*** and press <ENTER>
5. Insert the ICP Windows NT driver disk.
6. Select the ***ICP Disk Array Controller*** and press <ENTER>.

   IMPORTANT: Install the driver for the ICP Controller before you install any other drivers for additional adapters (e.g. IDE adapter for CD-ROM).
7. Setup tells you that it has recognized the ICP Controller. Press <ENTER> to continue.
8. Insert Disk #3 and press <ENTER>.
9. Now you can adjust the other system configuration parameters of your Windows NT system (graphics adapter, mouse, etc.).
10. Afterwards, the installation program scans the system for existing hard disks (which are identical to the Host Drives of the ICP Controller). Choose the drive on which to install Windows NT and which you want to partition.
11. Now the actual installation of the Windows NT operating system begins. Follow the instructions of the Windows NT installation program.
12. After successful installation, switch the *Delayed Write* function of the ICP Controller ON again by using the GDTSETUP program or the GDTMON program.

F.4.2 The ICP Controller is the Secondary Controller in the System

If you wish to use the ICP Controller as a secondary controller in your Windows NT system (e.g. Windows NT is installed on an IDE hard disk), follow the instructions a.) to h.) below:

a) Double click the ***My Computer*** icon.

b) Double click ***Control Panel***.

c) Double click ***SCSI Adapters***..

d) Click on ***Drivers***.

e) Click on ***Add***.

f) Click on ***Have Disk***.

g) Insert the ICP Windows NT driver disk and click ***OK***.

h) Select ***ICP Disk Array Controller***.

At the next system boot the ICP driver is loaded and the existing Host Drives are ready to be partitioned under Windows NT.

F.4.3 Using the Hot Plug Function with RAID Host Drives

In order to be able to use the Hot Plug function under Windows NT, it is necessary to load the GDTMON or RAID Navigator utility programs.

F.4.4 Installation of a new GDTX.SYS Driver Version

If it should become necessary to install a new version of the GDTX.SYS driver, the procedure is as follows:

a) Double click the ***My Computer*** icon.

b) Double click ***Control Panel***.

c) Double click ***SCSI Adapters***.

d) Click on ***Drivers***.

e) Select ***ICP Disk Array Controller***.

f) Click on ***Add***.

g) Click on ***OK***.
Windows NT informs you that this driver is already on the system and asks if you want to use the currently installed driver or a new one.

h) Click on ***New*** and insert the ICP Windows NT driver disk.

i) Click on ***Continue*** and NT copies the new driver to the disk.

At the next system boot the ICP driver is loaded.

F.5 Installation of a Removable Hard Disk

Removable hard disks (e.g., SyQuest, IOMEGA or magneto optical devices, MODs) are controlled by the ICP Controller in two fundamentally different modes:

Mode 1: The removable hard disk is treated like a normal hard disk. The data passes through the cache of the ICP Controller and the media needs to be initialized with GDTSETUP.

Mode 2: The removable hard disk is handled as a *Raw Device*. This means that the removable device is directly controlled by Windows NT without any further interaction of the controller. Consequently, the data is not cached by the ICP cache and the media does not need to be initialized with GDTSETUP. The advantage of mode 1 lies in a decisively better performance due to caching. On the other hand, the relatively complicated procedure of media changing presents a disadvantage. The opposite is true when adopting mode 2: The media change is easy and the media are compatible with other disk controllers (e.g., NCR). The performance is rather low since the data cannot be cached on the ICP Controller.
To install a removable hard disk as a Raw Device, the media must not be initialized with GDTSETUP and the device must be set to a SCSI-ID equal to or greater than 2. In addition, the parameters of the ICP driver GDTX.SYS need to be configured differently in the Windows NT R*egistry*

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\gdtx\Parameters\Device

To do so, follow these instructions:

1. Load the Registry Editor ***regedt32.exe*** in ***\...\system32***

2. Select the window ***HKEY_LOCAL_MACHINE on Local Machine***

3. Choose the Key ***gdtx*** in the directory ***SYSTEM\CurrentControlSet\Services*** .

4. Enter by means of Edit, function Add Key, the name ***Parameters*** .
   Select ***Parameters*** .

5. Enter by means of Edit, function Add Key, the name ***Device*** .
   Select ***Device*** .

6. Enter by means of Edit, function Add Value, the name ***DriverParameter*** .

7. Use data type ***REG_SZ.***
   Now enter the parameter string (e.g.): ***/reserve:0,0,4,0*** .
   (This string causes the SCSI device connected with ICP Controller 0, SCSI channel 0, SCSI ID 4, LUN 0 to be reserved as a Raw Device. ICP Controller 0 is the ICP Controller which is detected and configured first after switching on your computer system).

8. The reservation of the SCSI device becomes active after completing regedt32, exiting and rebooting the system.

F.6 Tips & Tricks

F.6.1 ICP Controller not Found During Windows NT Installation

We have observed situations where Windows NT can not find the ICP Controller when installing the ICP driver. This problem is usually caused by one of the standard drivers which Windows NT loads automatically during the first installation phase.
If this is the case, we recommend that Windows NT Setup be started again and carried out in the mode 'user defined'. If this process is carried out correctly, the scan for hard disk controllers carried out by Windows NT can then be omitted. Instead of carrying out a scan, the ICP driver will be installed manually immediately. The ICP Controller should then be easily found. If other disk controllers are in the system, they can also be specified manually after the ICP Controller.

F.6.2 Installation and Upgrade of Windows NT 3.5x / 4.x

Windows NT in the latest Versions 3.51 and 4.0 offers various methods for the installation and the upgrade.

Method 1: The corresponding Setup - Disks 1 to 3 are generated and Windows NT (the Upgrade) is installed by booting the disks.
In general, it is recommended to use method 1 for installing Windows NT, as the operating system always enables the user to insert an OEM disk (e.g., the driver disk of the ICP Controllers). In addition, installation is much faster if method 1 is used as not all Windows NT raw files have to be copied to a temporary directory.
Installation according to method 1 affords that 3 setup disks are generated. This is carried out via the program Winnt.exe on the Windows NT CD, i.e., by entering the command line:

WINNT /OX <ENTER>

The switch '/OX' ensures that the Setup disks are generated. This command must not be carried out in a DOS box, but under a normal DOS operating system.

Method 2: Windows NT generates a temporary directory on an existing partition and installs the operating system (i.e., the upgrade) from there.
This installation is only possible if there is already a partition with enough free disk space (around 150 MByte). Depending on whether it is an upgrade or a new installation, either WINNT.EXE has to be started with the corresponding command line option (e.g., 'WINNT /B' during a new installation via a temporary directory on a DOS Partition), or the Upgrade Icon on the CDROM symbol of the inserted Windows NT CDROM can be clicked on.
In any of these circumstances, Windows NT does not automatically enable the user to be able to insert an OEM disk. With all hard disk controllers, where the driver is not on the Windows NT CDROM, the following problem occurs: The access to the hard disk is not possible after the first reboot of the computer during the installation procedure. Normally, the error message 'Inaccessible Boot Device' appears and the installation is stopped.
To avoid this error message, a ' hidden key ' of Windows NT should be used. As soon as the NT operating system has restarted the computer (reset), and the setup program starts, the key F6 has to be pressed and held down when the Setup screen appears. The Setup screen appears before the symbol for the Windows NT-Version and the system RAM is displayed in the upper corner of the screen. This is easily recognizable by a blue background color. In contrast to the 'Boot-Screen' with the version message and RAM message, the setup screen uses the large screen font.
After pressing F6, a window is opened and Windows NT offers the opportunity of specifying an additional device driver. Now insert the floppy disks with the Windows NT driver for the ICP Controller. If the whole process described above has been carried out correctly, a window is displayed in the middle of the screen with the message 'ICP Disk Array Controller'.
If the function key F6 was not pressed at the correct point, the procedure can be easily repeated by rebooting the computer (hard reset).
Otherwise, Windows NT restarts the driver of the ICP Controllers after confirming by pressing the <ENTER>-key. Installation can be carried out in the usual way. The ICP driver disk will be needed again later to allow Windows NT to copy the gdtx.sys to the boot partition.

F.6.3 Adding Additional Capacity After An Online Capacity Expansion

The additional capacity resulting from an online capacity expansion of an existing Array Drive is introduced to the system as a new Host Drive. In order to be able to make use of the new capacity without having to down the server, use the *Disk Administrator*. When loading, it detects the new Host Drive.

F.6.4 Windows NT Error Messages and Possible Reasons

Setup did not find any hard disk drivers installed in your computer.

Possible reasons:

- The automatic hardware detection was not skipped or the driver for the ICP Controller was not installed as the first driver. NT Setup always expects the partition on which NT should be installed on a drive of the first controller.
- The NT Setup was booted from an IDE or SCSI CDROM and NT has carried out an automatic hardware detection.
- There are no Host Drives on the installed ICP Controller.

Setup is unable to locate the hard drive partition prepared by the MS-DOS portion of Setup.

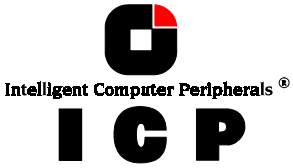
The three installation disks were not created with the "/OX" switch. Thus, NT Setup requires a MS-DOS partition for the installation. Use the "/OX" switch to create a new set disks.

The SCSI adapter, CD-ROM drive, or special disk controller you specified is not installed in your computer.

Possible reasons:

- The ICP Windows NT driver disk is not complete. The GDTX.SYS driver and the OEMSETUP.INF files are missing. The reason could be that you copied the files from the ICP System CDROM to the ICP Windows NT driver disk with the Explorer.
- A defective floppy disk. Take a new one and make a new ICP Windows NT driver disk.
- There is a PCI resource conflict. Open Jumper S4 on the ICP Controller PCB and change within GDTSETUP the DPMEM setting to "do not move" (load GDTSETUP, select the controller, press F2 for *Advanced Setup*, select *Configure Controller*, select *Advanced Settings*, change DPMEM *mapping* to *do not move*).

.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Chapter G

Using LINUX

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ICP

G. Using LINUX

After having explained the installation of the ICP Controller and the host drives in chapters B and C, we now explain how to install the operating system LINUX.
For a successful installation, we recommend that you take a close look at the manuals which came with your LINUX distribution package.
We have tested LINUX from: Caldera, Debian, DLD, LST, RedHat and S.u.S.E. .

G.1 Transparency of Host Drives

The structure of the Host Drives, which have been installed with GDTSETUP (in chapter C), is not known to LINUX. I.e., the operating system does not recognize that a given Host Drive consists of a number of hard disks forming a disk array. To LINUX, this Host Drive simply appears as one single hard disk with the capacity of the disk array. This complete transparency represents the easiest way to operate disk arrays under LINUX; neither LINUX nor the PCI computer need to be involved in the administration of these complex disk array configurations.

G.2 Available Drivers and Tools

gdth.tgz	ICP driver sources for intel and alpha systems
gdtp2036.gz	ICP driver patch for Kernel 2.0.36 (intel & alpha)
gdtmon.tgz	GDTMONitor and object files (intel)
gdtmona.tgz	GDTMONitor and object files (alpha)

The following ICP drivers are part of the various Kernel versions:

from Kernel 2.0.31	ICP driver 1.00
from Kernel 2.0.35/2.1.63	ICP driver 1.02
from Kernel 2.0.36	ICP driver 1.07
from Kernel 2.2.0 (pre7)	ICP driver 1.10

G.3 Updating the driver using the driver sources

a) Copy the driver sources to /usr/src/linux/drivers/scsi
(for a DOS disk for example with 'mcopy a:gdth.tgz')

b) Unpack the archive with 'tar xvfz gdth.tgz

c) Compile a new Kernel
(procedure depends on the Linux distribution, 'make config', 'make dep', 'make clean' may become necessary before)

G.4 Driver installation or update using a patch

New installation of a driver patch:

a) Copy the corresponding patch on the Linux system
(preferably to /usr/src/linux e.g. gdtp2036.gz for Linux 2.0.36)

b) Carry out the patch, e.g. for Linux 2.0.36:
cd /usr/src/linux
zcat gdtp2036.gz | patch -p1 2>log_file
Thereafter check the file log_file for possible errors

c) Configure the Kernel / Enter the ICP Controller with:
cd /usr/src/linux
make config

d) Check dependencies / Compile Kernel:
see LINUX manual (e.g. make dep && make zlilo)

e) Reboot system

U*pdate of a driver patch*:

a) Copy the new patch to /usr/src/linux

b) Remove old patch with
zcat old_patch.gz | patch -p1 -R
rm drivers/scsi/gdth*
(gdth sources with versions older than 1.01 have to be removed with rm manually. With newer versions this is no longer necessary.)

c) Carry out the patch
zcat new_patch.gz | patch -p1 2>log_file

d) Compile a new Kernel

e) Reboot the system

G.5 GDTMON - Monitoring Tool

Detailed information on GDTMON can be found in a separate chapter of this User's Manual.

gdtmon.tgz	GDTMONitor and object files (intel)
gdtmona.tgz	GDTMONitor and object files (alpha)

These archives include all object files to create gdtmon, as well as an executable gdtmon compiled on a current Linux version. If you encounter problems with this executable gdtmon, you can easily compile a new gdtmon on your own Linux system:

unpack the tgz-file:	'tar xvfz gdtmon.tgz'
compile gdtmon:	'make'
start gdtmon:	'./gdtmon'

In order to be able to compile gdtmon you need the C-compiler and the Kernel sources on your system. The link /usr/src/linux has to point to the Kernel sources which correspond with the currently booted Kernel of your system. This is important for "signature.c" to use the right magic for the communication with the driver. Otherwise it may happen that you get "Wrong signature" when trying to start gdtmon.

G.6 gdth driver parameters

Driver versions older than 1.05 do not support driver parameters. From driver version 1.05 to 1.07 it is necessary to add driver parameters directly in /usr/src/linux/drivers/scsi/gdth.c . From version 1.10 on you may use for the parameters the LILO boot prompt (gdth=...") or in /etc/lilo.conf the append command (append = "gdth=...").

Reservation of SCSI devices:

The reservation of SCSI devices becomes necessary if you wish that so-called 'Direct Access Devices' (e.g. hard disks, removable hard disks like IOMEGA or SyQuest, some MOs) are directly controlled by Linux and not the ICP Controller's firmware (i.e., they are not configured as Host Drives). This is also called "raw-service". In this case the ICP Controller does not cache the data to/from the reserved SCSI device. This reservation is important for removable hard disks. If they are controlled by the ICP Controller and are a Host Drive, a media change is very difficult. 'Non Direct Access Devices' like CD-ROMs, Streamers, DATs, etc. do not require a reservation. IMPORTANT: The reservation is only possible with not-initialized SCSI devices. (Use GDTSETUP to de-initialize an already initialized device).

As already mentioned a reservation for driver versions 1.05 to 1.07 has to be made directly in the driver sources. Look for 'gdth_reserve_str' in '/usr/src/linux/drivers/scsi/gdth.c' . You'll find a non-active sample entry, which you can change according to the coordinates of the device you want to reserve (enter Adapter, Bus, ID and LUN). Save the file and compile a new kernel.

From driver version 1.10 on you can add the parameters for the reservation with the LILO append command:

Excerpt of /etc/lilo.conf:

```
# End LILO global section
# Linux bootable partition config begins
image = /boot/vmlinuz
root = /dev/sda2
label = Linux
append = "gdth=reserve_list:1,0,6,0"
# Linux bootable partition config ends
```

This gdth driver parameter reserves the SCSI device which is connected with ICP Controller 1 (second ICP Controller), SCSI Bus 0 (channel A), ID 6, LUN 0 for Linux (raw service).

After each change in /etc/lilo.conf , lilo must be loaded once.

Driver parameters may also be entered at the LILO boot prompt.
(e.g.: gdth=reserve_list:1,0,6,0).

***Further driver parameters*:**

irq1,irq2, etc.	Only for ICP EISA Controllers with disabled BIOS (irq1, irq2, etc. correspond with the IRQs of the ICP Controllers)
disable:Y	deactivates the ICP driver
disable:N	activates the ICP driver
reserve_mode:0	reserves no SCSI devices [*1]
reserve_mode:1	reserves all not-initialized removable hard disk [*1]
reserve_mode:2	reserves all not-initialized SCSI devices [*1]
reserve_list:h,b,t,l,h,b,t,l,	reserves SCSI devices at the corresponding coordinates with h=Hostadapter, b=SCSI Bus, t=Target ID, l=LUN
reverse_scan:Y	reversed scanning order of the PCI controllers
reverse_scan:N	normal scanning order of PCI Controllers according to the system BIOS
max_ids:x	x = number of target IDs per SCSI channel (accelerates the boot process)
rescan:Y	rescan all SCSI channels / IDs
rescan:N	scan only those SCSI devices found during system power up [*1]

[*1] The driver parameters reserve_mode and rescan:N require ICP Controllers with firmware version FW 1.23.00/2.23.00 or higher.

The current default settings of the driver are:

"gdth=disable:N,reserve_mode:1,reverse_scan:N,max_ids:127,rescan:N"

If gdth is loaded as a module, these parameters can also be added with a special syntax. IRQ parameters are entered as 'IRQ=' (e.g. IRQ=10). Several parameters are not separated with a comma (',') but a space (' '). All ':' are substituted with '=', all 'Y' with '1' and all 'N' with '0'.

Default: "modprobe gdth disable=0 reserve_mode=1 reverse_scan=0 max_ids=127 rescan=0"

G.7 Notes

Further interesting information:

/proc-Support:

Read of /proc/scsi/gdth/0, /proc/scsi/gdth/1, .. :
Displays the ICP Controller/SCSI busses, firmware version, driver version (e.g.: cat /proc/scsi/gdth/0)

Write to /proc/scsi/gdth/0, .. :

gdth flush	Flush all Host Drives of the ICP Controller
gdth flush drive	Flush the Host Drive with the number drive
gdth wbp_off	Disable Write-Back permanently
gdth wbp_on	Enable Write-Back permanently
gdth wb_off	Disable Write-Back for this session (from Firmware version 1.15/2.15)
gdth wb_on	Enable Write-Back for this session (from Firmware version 1.15/2.15)

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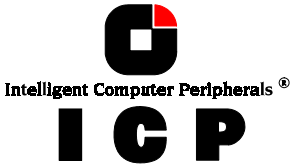
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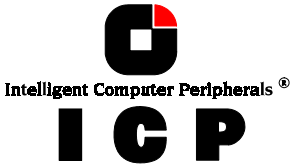
Chapter H

Using SCO UNIX



H. Using SCO UNIX V/386

After having explained in chapters B and C the installation of the ICP Controller as well as that of the Host Drives, we would now like to give you a few hints regarding the installation of the operating systems

SCO UNIX V/386 3.2v4.x, 3.2v5.x (O*pen* S*erver*)

For a successful installation, it is essential to read the SCO system manuals thoroughly.

H.1 Transparency of Host Drives

The structure of the Host Drives, which have been installed with GDTSETUP (in chapter C), is not known to UNIX. I.e., the operating system does not recognize that a given Host Drive consists of a number of hard disks forming a disk array. To UNIX this Host Drive simply appears as one single hard disk with the capacity of the disk array. This complete transparency represents the easiest way to operate disk arrays under UNIX; neither UNIX nor the PCI computer need to be involved in the administration of these complex disk array configurations.

H.2 General Tips for Installation

In the following description, we shall explain the installation of SCO UNIX V/386 3.2v4.x and 3.2v5.x step by step in combination with the ICP Controller. Apart from the SCO UNIX floppy disks and the SCO UNIX documentation, you also need the ICP floppy disks (they can be created from the ICP System CDROM):

ICP SCO UNIX BTLD-Disks for 3.2v4.x, 3.2v5.x

for the installation. In the following discussion, when we speak of a *boot drive* we refer to the drive which is first integrated upon system power up. For the ICP Controller this drive is the first Host Drive in the list of ICP Host Drives, i. e., the Host Drive number 0 (see GDTSETUP menu C*onfigure* H*ost-Drives*). During the installation you will have to decide whether you want the ICP Controller to make the boot drive available, or whether you want to operate the ICP Controller as an additional controller in the computer system.
If the ICP Controller is the only hard disk controller in the computer system, it will automatically make the boot drive available. If there are more hard disk controllers, the controller which makes the first drive available (the drive containing the MS-DOS partition C:) will be the boot controller.

In principle, SCO UNIX is always installed on the hard disk with Target ID 0 and LUN 0 on host adapter 0, that is on Host Drive 0 of this controller. If SCO UNIX is installed from tape (streamer) the streamer must have SCSI ID 2 and be connected with SCSI channel A of host adapter 0. For an installation from CD-ROM, the CD-ROM device must have SCSI-ID 5 and has to be connected with channel A of the ICP Controller.

When using 3.2v4.x or 3.2v5.x, you have the option to link the driver to the kernel before starting the kernel (*btld* (ADM)). This will allow you to use the ICP Controller as the only controller in the system. Use the ICP BTLD D*isk*. During the installation, whenever the N1 floppy disk is inserted and the message

B*oot*
:

is displayed, do not press <ENTER> immediately, but type in *link* <ENTER>. The system will then prompt you for the name of the BTLD driver. Now type in *gdth*. It may be necessary to type in the complete boot string. In this case, you have to add the following command:

link=gdth btld=fd(xx)

where xx is the "Minor Device Number" of the corresponding device file. xx = 60 for fd0135ds18, 3,5" floppy as A,: or xx = 61 for fd1135ds18, 3,5" floppy as B: (see SCO UNIX system Administrator's Reference, Hardware Dependence, floppy devices). When requested, enter the IRQ which has been assigned to the PCI INT of the ICP Controller (see chapter B, Hardware Installation). In addition, the ICP BIOS must not be disabled and the boot drive must be connected with the ICP Controller having the lowest PCI slot number. When the UNIX installation has been completed, the driver is installed, too, and you may install further devices with *mkdev hd* (ADM).

If the ICP Controller is an additional controller, the installation of the driver is carried out with *installpkg*.

H.3 Instructions on mkdev (ADM) for 3.2v4.x

Whenever the program *mkdev hd* (ADM) is started, you will be asked for the coordinates of the device you wish to install. The driver does not automatically display all devices connected, so after the installation you will find a tool named **GDTSCAN** in the directory '/etc'. The scanning can take up to several seconds, especially when there is more than one controller in the system. The devices are displayed together with their host adapter number, target-ID and LUN. These values are to be used in *mkdev* (ADM). Let's have a brief look at how the HA-no., target-ID and LUN are determined. Please note that the UNIX driver always maps the first detected Host Drive with target-ID 0, LUN 0. Exactly this drive would be used as a boot drive when the ICP Controller is to make the boot drive available.

Host adapter Number (HA)

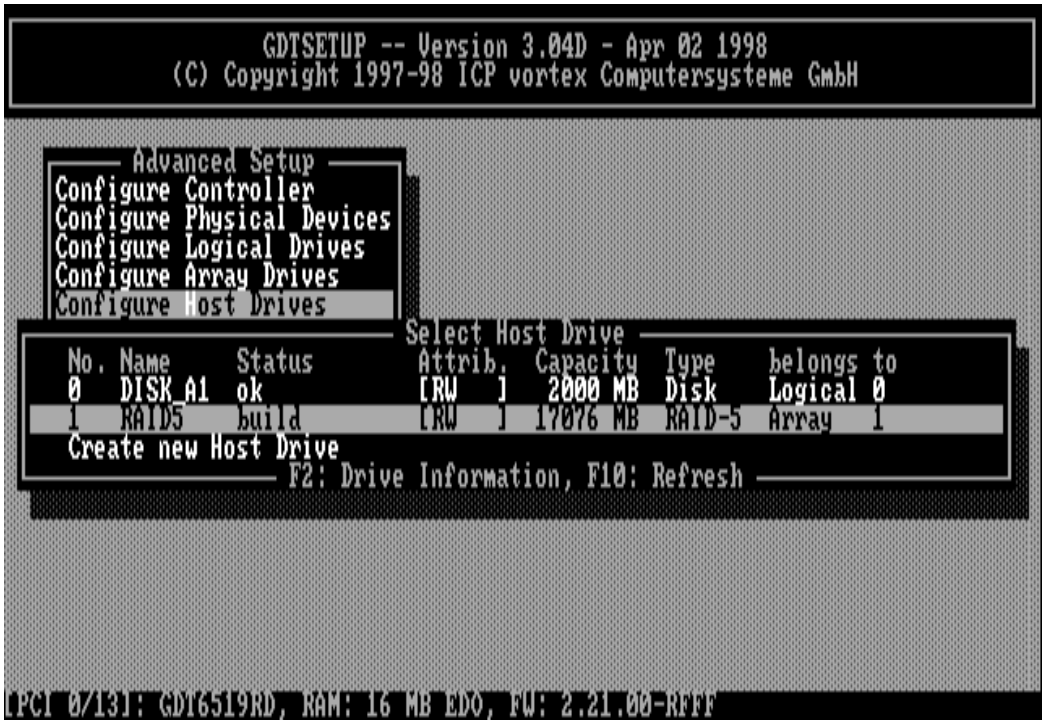
The host adapter number assigned to the ICP Controller is derived from the PCI slot number of the ICP Controller. Therefore, if there is only one ICP Controller installed in the PCI bus computer system, the host adapter number=0. If there are two ICP Controllers installed, the ICP Controller with the lower PCI Slot number is assigned host adapter number 0 and the ICP Controller with the higher PCI slot number is assigned host adapter 1. (Note: After a cold boot, the ICP BIOS displays a couple of messages, each beginning with the controller's PCI slot number, e.g. "[PCI 0/3] 4 MB RAM detected". The number after the '/' is the slot number of the controller. This helps you to determine which is the order of the ICP Controllers and which host adapter number is assigned to them by UNIX. See also chapter B, Hardware Installation).

UNIX Target-ID and LUN

Target-IDs 0 and 1 with LUN 0 to 7 are reserved for **"Direct Access Devices"** (devices behaving like a hard disk or a removable hard and therefore configurable with GDTSETUP). There is a correlation between the Host Drive number GDTSETUP assigns (menu *Configure Host Drives*), and the assigned target-ID and LUN:

Host-Drive Number = 8 * Target-ID + LUN

The Host Drive number is the number the drive is given in the list of available Host Drives in the GDTSETUP program. The following exemplary screen shows a list of Host Drives. In this example, there are two Host Drives installed.



Therefore, the first Host Drive has target-ID 0 / LUN 0 and the second target-ID 0 / LUN 1. The formula for determining target ID and LUN from the existing Host Drive numbers yields the following possible combinations for "Direct Access Devices":

Host Drive number	Target ID	LUN	Host Drive number	Target ID	LUN
0	0	0	8	1	0
1	0	1	9	1	1
2	0	2	10	1	2
3	0	3	11	1	3
4	0	4	12	1	4
5	0	5	13	1	5
6	0	6	14	1	6
7	0	7	15	1	7

This conversion is necessary because the single SCSI devices are not declared to the host operating system in the order of their SCSI-IDs anymore, but according to the Host Drive numbers they have in GDTSETUP. Host Drives are a prerequisite for the ICP Controller to be able to link several SCSI devices to form a higher structure (i.e., RAID 5).
The sequence of the single Host Drives can be changed very easily by having GDTSETUP sort them in its *Configure Host Drives* menu. In this way, it is also possible to change the boot

drive (it had previously been selected as boot drive because it has the lowest drive number, that is, 0, and is therefore the first drive to be communicated to the system).

Target ID and LUN of "**Not Direct Access Devices**" (devices such as streamers, tapes, CD-ROMS, etc., not configurable with GDTSETUP) are determined on the basis of the SCSI-ID and the SCSI channel used by the ICP Controller. These devices can only be configured with SCSI-IDs 2 to 6. SCSI-ID 0 and 1 are reserved for hard disks, SCSI-ID 7 for the ICP Controller. If "Not Direct Access Devices" are configured on SCSI-ID 0 or 1, they are not recognized during the scanning process and can therefore not be used. The Target IDs of *Not Direct Access Devices* are identical to their SCSI-ID, the LUN depends on the SCSI channel used (LUN 0 for SCSI channel A and LUN 4 for SCSI channel B). Note: After a cold boot the ICP BIOS displays all connected devices with their physical coordinates, i. e. their SCSI-ID and SCSI-LUN, (see "Chapter B, ICP Controller Function Check").

SCSI-ID of Not Direct Access Devices	***Used ICP SCSI channel***	***UNIX Target ID***	***UNIX LUN***
2	A	2	0
3	A	3	0
4	A	4	0
5	A	5	0
6	A	6	0
2	B	2	4
3	B	3	4
4	B	4	4
5	B	5	4
6	B	6	4

Having to determine the Target ID and LUN in such a complicated manner might seem rather awkward. However, it is necessary to do so because the ICP Controllers have more than one SCSI channel, whereas UNIX can only manage host adapters with one SCSI channel. Therefore, the ICP UNIX driver has to make the appropriate transformations.

Configuration Example:

In the PCI computer are two ICP Controllers (HA 0 = 1st ICP, HA 1 = 2nd ICP), each with two SCSI channels.

1 hard disk	as Host Drive no. 0 on HA0
1 hard disk	as Host Drive no. 0 on HA1
1 hard disk	as Host Drive no. 1 on HA1
1 Streamer	SCSI-ID 2, LUN 0 on SCSI channel A of HA0
1 CD-ROM	SCSI-ID 3, LUN 0 on SCSI channel A of HA0
1 DAT	SCSI-ID 2, LUN 0 on SCSI channel B of HA1

Result:

HA	Target-ID	LUN	Device
0	0	0	1st hard disk, Host Drive no. 0 (boot- and installation drive)
0	2	0	Streamer
0	3	0	CD-ROM
1	0	0	hard disk, Host Drive no. 0
1	0	1	hard disk, Host Drive no. 1
1	2	4	DAT

H.4 Instructions on mkdev (ADM) for 3.2v5.x (Open Server)

Whenever the program *mkdev hd* (ADM) is started, you will be asked for the coordinates of the device you wish to install. The driver does not automatically display all devices connected, so after the installation you will find a tool named **GDTSCAN** in the directory '/etc'. The scanning can take up to several seconds, especially when there is more than one controller in the system. The devices are displayed together with their host adapter number, target-ID and LUN. These values are to be used in *mkdev* (ADM). Let's have a brief look at how the HA-no., target-ID and LUN are determined. Please note that the UNIX driver always maps the first detected Host Drive with target-ID 0, LUN 0. Exactly this drive would be used as a boot drive when the ICP Controller is to make the boot drive available. As an alternative for the following "new" mapping method of SCO UNIX V/386 3.2v5.x, you may also use the mapping as described in section H.3 (for 3.2v2.0 & 3.2v4.x). To enable this ("old") mapping, change in the

/etc/conf/pack.d/gdth/space.c
gdth_mapping=1 into
gdth_mapping=0

Host adapter Number (HA)

The host adapter number assigned to the ICP Controller is derived from the PCI slot number of the ICP Controller. Therefore, if there is only one ICP Controller installed in the PCI bus computer system, the host adapter number=0. If there are two ICP Controllers installed, the ICP Controller with the lower PCI Slot number is assigned host adapter number 0 and the ICP Controller with the higher PCI slot number is assigned host adapter 1. (Note: After a cold boot, the ICP BIOS displays a couple of messages, each beginning with the controller's PCI slot number, e.g. "[PCI 0/3] 4 MB RAM detected". The number after the '/' is the slot number of the controller. This helps you to determine which is the order of the ICP Controllers and which host adapter number is assigned to them by UNIX. See also chapter B, Hardware Installation).

UNIX Target-ID and LUN

Target-IDs and LUNs for **"Not Direct Access Devices"** (devices like streamers, tapes and CD-ROMs and therefore not configurable via GDTSETUP), are directly assigned to the SCSI-ID and the channel of the ICP Controller. Host Drives are assigned in increasing order to the free coordinates (bus number and target ID;LUN is always 0).

Configuration Example:

In the PCI computer are two ICP Controllers (HA 0 = 1st ICP, HA 1 = 2nd ICP), each with two SCSI channels.

1 hard disk	as Host Drive no. 0 on HA0
1 hard disk	as Host Drive no. 0 on HA1
1 hard disk	as Host Drive no. 1 on HA1
1 Streamer	SCSI-ID 2, LUN 0 on SCSI channel A of HA0
1 CD-ROM	SCSI-ID 3, LUN 0 on SCSI channel B of HA0
1 DAT	SCSI-ID 2, LUN 0 on SCSI channel A of HA1

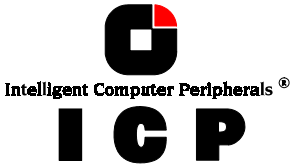
Result:

HA	Bus	Target-ID	LUN	Device
0	0	0	0	1st hard disk, Host Drive no. 0 (boot drive)
0	0	2	0	Streamer
0	1	3	0	CD-ROM
1	0	0	0	hard disk, Host Drive no. 0
1	0	1	0	hard disk, Host Drive no. 1
1	0	2	0	DAT
1	0	3	0	hard disk, Host Drive no.2

Important Note: 'Not Direct Access Devices' must not be connected to Bus 0, Target-ID 0, LUN 0. This is reserved for the boot device under SCO Unix 3.2V5.0

H.5 Further Information

- From version 4.x of SCO UNIX V/386 3.2, a media change can be made with the UNIX commands **MOUNT** and **UNMOUNT**. Please make sure that the removable hard disk keeps its GDTSETUP drive number when changing the media, otherwise a separate ID/LUN entry is necessary for each single media (since the drive number depends on the media and not the device containing it).
- SCO UNIX V/386 3.2v4.x and later versions support a maximum of 4 ICP Controllers in one computer system.
- The tool **GDTSYNC** in the directory '/etc' carries out a UNIX SYNC command (update super block) and causes all buffers still present in ICP's cache to be written to the Logical Drives. It is advisable to use this tool before shutting down the system.
- When using *Direct Access Devices* with **exchangeable media** (e.g., removable hard disks), a media has to be inserted when the system is booted, otherwise the device is not available under UNIX.
- "Not Direct Access Devices" (streamer, tapes, CD-ROMs, etc) can be switched on even after system power up, they will still be recognized by **GDTSCAN** afterwards.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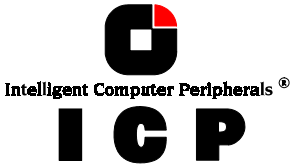
Chapter 1

Using UnixWare



I. Using UnixWare

After having exposed the installation of the ICP Controller as well as that of the Host Drives in chapters B and C, we would now like to give you some hints and pieces of advice on how to install the operating system UnixWare version 2.x and UnixWare 7.

I.1 Transparency of Host Drives

The structure of the Host Drives, which have been installed with GDTSETUP (in chapter C), is not known to UNIX. I.e., the operating system does not recognize that a given Host Drive consists of a number of hard disks forming a disk array. To UNIX, this Host Drive simply appears as one single hard disk with the capacity of the disk array. This complete transparency represents the easiest way to operate disk arrays under UNIX; neither UNIX nor the PCI computer need to be involved in the administration of these complex disk array configurations.

I.2 General Installation Notes

In the following description, we shall explain the installation of UnixWare in connection with the ICP Controller step by step. Apart from the UnixWare floppy disks, the CD-ROM and the UnixWare documentation, you also need the ICP floppy disk (can be created from the ICP System CDROM):

U*nix*W*are* BTLD-D*isk*

In the following discussion, when we speak of a *boot drive* we refer to the drive which is first integrated upon system power up. For the ICP Controller, this drive is the first Host Drive in the list of ICP Host Drives, i. e. the Host Drive with number 0 (see GDTSETUP menu C*onfigure* H*ost*-D*rives*). During the installation you will have to decide whether you want the ICP Controller to make the boot drive available, or whether you want to operate the ICP Controller as an additional controller in the computer system. If the ICP Controller is the only hard disk controller in the computer system, it will automatically make the boot drive available.

If there are more hard disk controllers, the controller which makes the first drive (the drive containing the MS-DOS partition C:) available will be the boot controller. If the ICP Controller does not make the boot drive, you can skip the following paragraph.

I.3 ICP Controller as Boot Controller

There must be a Host Drive on the first ICP Controller found during a cold boot. In addition, the ICP BIOS must be enabled and the SCSI-ID of the corresponding ICP SCSI channel must be set to 7.

Now you can begin the installation. Boot the system with the first UnixWare boot disk. UnixWare scans the system for host adapters. When requested insert the U*nix*W*are* BTLD-D*isk*. The installation procedure which follows then has to be carried out as described in the UnixWare documentation.
Important note: As already mentioned in chapter B “Hardware Installation”, the assignment of an IRQ to an INT is made by the PCI System BIOS. The UnixWare versions 2.xy and higher automatically recognize the IRQ of a PCI expansion card.

I.4 ICP Controller as an additional Controller

We distinguish two cases.

a.) No ICP Controller has been configured for UnixWare yet.
In this case, the ICP driver must be installed from the U*nixWare* BTLD-D*isk* by means of the UnixWare desktop and the options "System Setup", "Application Setup". Alternatively, this procedure can be carried out from the UnixWare shell: "*pkgadd -d /dev/dsk/f0t*" (ICP driver disk in drive 0).

b.) An ICP Controller has already been configured for UnixWare.
In this case, you only have to add an additional entry for the new ICP Controller. This is carried out by

/etc/scsi/pdiadd -d DRQ *-v* IRQ *-m* MEM *gdth*

for DRQ use 0 (not necessary for PCI boards), for IRQ write the IRQ number the ICP Controller uses. MEM corresponds with the DPMEM address of the ICP Controller (which is displayed in the BIOS message of the ICP Controller after power up). In both cases, you have to carry out a cold boot in order to use the new ICP Controller under UnixWare.
Example: /etc/scsi/pdiadd -d 0 -v 12 -m c8000 gdth.
After that, a reboot of the UnixWare system is necessary. No kernel link is required because the driver will be dynamically loaded.

I.5 Coordinates of SCSI devices

a.) Host adapter Number (HA)

The host adapter number assigned to the ICP Controller is derived from the PCI slot number of the ICP Controller. Therefore, if there is only one ICP Controller installed in the PCI bus computer system, the host adapter number=0. If there are two ICP Controllers installed, the ICP Controller with the lower PCI Slot number is assigned host adapter number 0 and the ICP Controller with the higher PCI slot number is assigned host adapter 1. (Note: After a cold boot, the ICP BIOS displays a couple of messages, each beginning with the controller's PCI slot number, e.g. "[PCI 0/3] 4 MB RAM detected". The number after the '/' is the slot number of the controller. This helps you to determine which is the order of the ICP Controllers and which host adapter number is assigned to them by UnixWare. See also chapter B, Hardware Installation).

b.) UnixWare Bus number, Target-ID and LUN

Target-IDs and LUNs for **"Not Direct Access Devices"** (devices like streamers, tapes and CD-ROMs and therefore not configurable via GDTSETUP), are directly assigned to the SCSI-ID and the channel of the ICP Controller. Host Drives are assigned in increasing order to the free coordinates (bus number and target ID;LUN is always 0).

Configuration Example:

In the PCI computer are two ICP Controllers (HA 0 = 1st ICP, HA 1 = 2nd ICP), each with two SCSI channels.

1 hard disk	as Host Drive no. 0 on HA0
1 hard disk	as Host Drive no. 0 on HA1
1 hard disk	as Host Drive no. 1 on HA1
1 Streamer	SCSI-ID 2, LUN 0 on SCSI channel A of HA0
1 CD-ROM	SCSI-ID 3, LUN 0 on SCSI channel B of HA0
1 DAT	SCSI-ID 2, LUN 0 on SCSI channel A of HA1

Result:

HA	Bus	Target-ID	LUN	Device
0	0	0	0	1st hard disk, Host Drive no. 0 (boot drive)
0	0	2	0	Streamer
0	1	3	0	CD-ROM
1	0	0	0	hard disk, Host Drive no. 0
1	0	1	0	hard disk, Host Drive no. 1
1	0	2	0	DAT
1	0	3	0	hard disk, Host Drive no.2

I.6 Further Information

- During the installation of the ICP driver, additional tools are copied into the /etc directory. Before you can use them you have to create a special device file named /dev/rgdth by means of "link"; this device file has to be placed on a device of an ICP Host Drive. With 'gdtsync' from the /etc directory, you can determine the coordinates of an ICP Host Drive. Usually the first Host Drive has the coordinates c0b0t0d0.
  A special device file (character device) is '/dev/rdsk/c0b0t0d0s0. In this case, /dev/rgdth can be generated with: *ln /dev/rdsk/c0b0t0d0s0 /dev/rgdth*.
  (c0 = HA, b0 = Bus number, t0 = Target-ID 0, d0 = LUN 0, s0 = UnixWare partition).

- All new SCSI devices will be automatically recognized and a corresponding special-device-file will be generated

- Host Drives must be partitioned and a file system/file system(s) must be created. You can do this with *diskadd cCbBtTdD*.

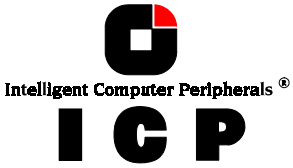
- When using *Direct Access Devices* with **exchangeable media** (e.g., removable hard disks) that are not reserved for the raw service, a media has to be inserted either when the system is booted, or with GDTSETUP (mount/unmount), otherwise the device is not available under UnixWare.

- The ICP UnixWare driver supports *Direct Access Devices* (e.g., hard disks, removable hard-disks) as SCSI-raw devices. This is especially important if you use removable hard disks which you want to exchange with other controllers. How to reserve a device for the SCSI-raw service is described in the file *space.c* on the ICP BTLD disk (example and documentation).

- Multi-processor support: The ICP device drivers for UnixWare 2.xy and 7 support multi-processor systems.

Chapter J

GDTMON



J. The Diagnosis Program GDTMON

GDTMON (GDT monitor) is a helpful and flexible diagnosis tool for the monitoring, maintenance and tuning of mass storage subsystems which are based on one or more ICP Controllers. Different to the **ICP RAID Navigator** (a GUI-sytle application for Windows 9x/NT), GDTMON's user interface is character-oriented. Information on the ICP RAID Navigator can be found in a separate chapter of this User's Manual.

The key features of GDTMON:

- Diagnosis program with a character-oriented graphical user interface. Clear performance representation with variable horizontal bars
- Available under MS-DOS, NetWare 3.x & 4.x, Windows 9x, Windows NT, OS/2, SCO UNIX, Linux
- Loadable locally (on the server) or remotely from an authorized workstation (support of various protocols)
- Indicates the performance, expressed in [KB/sec] and [IO/sec], of:
  - Host Drives (Disk, Chain, RAID 0, 1, 4, 5, 10)
  - Logical Drives
  - SCSI Drives and FCAL Drives
- Indicates the ICP cache utilization
  - Read-Hits
  - Write-Hits
  - Separate indication for data- and parity-cache (RAID 4/5)
- Allows online changing of the ICP cache parameters:
  - Cache ON/OFF
  - Delayed Write ON/OFF
- Allows online changing of the devices' parameters:
  - SCSI protocol
  - Synchronous or Asynchronous data transfer
  - Setting of the synchronous data transfer rate
  - Disconnect/Reconnect
  - Disk Cache ON/OFF
  - Tagged Queues ON/OFF
- Indicates the structure of Logical, Array and Host Drives
- Performs online parity checking of RAID 4 and RAID 5 Host Drives
- Allows the online RAID Level migration and capacity expansion of existing Array Drives
- Saves all relevant configuration data to floppy disk or hard disk
- Sets up or removes RAID 1 Disk Arrays while maintaining full operational conditions
- Performs Hot Plugs on RAID 4 / RAID 5 disk arrays
- Allows to add or remove a dedicated or pool Hot Fix drive while maintaining full operational conditions

J.1 Loading GDTMON

As mentioned before, the GDTMON program is available for various operating systems. It can be used either locally or remotely. This means that all ICP Controllers in a network can be monitored and serviced from one (or several) workstation(s). The communication between the ICP Controller(s) and the GDTMON program is based on the NETBIOS or NCPE protocols. Thus, for example, it is possible to monitor the ICP Controller in an OS/2 workstation or the ICP Controller in the Novell NetWare fileserver from a Windows 95/98 workstation.
In order to be able to access a certain computer system with its ICP Controller remotely on the network, a special communication module has to be loaded first, which routes the information through the network. For a Novell NetWare fileserver this is the CTRLSRV.NLM module (NCPE). For Windows NT (server and workstation), Windows 95/98 and OS/2 (server and workstation) this is the NBSERVx.EXE module (NETBIOS). While the module is loaded it searches for a CTRLSRV.CFG (Novell NetWare) or NBSERV.CFG (Windows NT, Windows 95/98 and OS/2) file, which includes the definition of the access rights of the different users and their passwords. The CFG file assigns every user to two different access levels. Access level 0 gives the user all functions to view and change the controller-, disk-drive and disk-array-settings. Access level 1 entitles the user only to view the various settings and performance data.
The Windows NT, Windows 95/98 and OS/2 driver disks (on the ICP System CDROM) include so-called DLLs for the supported protocols. Example: If the MON4NETB.DLL file is located in the same directory as GDTMON.EXE file for Windows NT, the NETBIOS protocol is automatically used for the GDTMON on this system. As soon as the NETBIOS support of this operating system is installed during the network configuration, the GDTMON on this system can communicate through this protocol with another system in the network which has an ICP Controller.
The following drivers for the 'remote' GDTMONitor are currently available:

OS/2

GDTMON32.EXE	GDTMONitor for OS/2
MON2NETB.DLL	NETBIOS DLL for OS/2
MON2NCPE.DLL	NCPE DLL for OS/2
NBSRV2.EXE	NETBIOS Server for OS/2
NBSRV.CFG	Configuration file for NetBios Server
NBCLEAN2.EXE	NETBIOS analysis program

Windows NT

GDTMON.EXE	GDTMONitor for Windows NT
MON4NETB.DLL	NETBIOS DLL for Windows NT
ICPSRV.EXE	ICP Service for Windows NT
ICPSRV.CPL	for ICP Service
NBCLEAN4.EXE	NETBIOS analysis program

Windows 95/98

GDTMON.EXE	GDTMONitor for Windows 9x
MON5NETB.DLL	NETBIOS DLL for Windows 9x
NBSRV5.EXE	NETBIOS Server for Windows 9x
NBSRV.CFG	Configuration file for NETBIOS Server
NBCLEAN5.EXE	NETBIOS analysis program

The MS-DOS GDTMON also allows remote access. The DLLs are integrated into the GDTMON.EXE file, thus there is no NETBIOS server available for MS-DOS. Since there is no NETBIOS support within MS-DOS, it is necessary to load the NETBIOS program to access from a MS-DOS workstation through the network an ICP Controller in a Windows NT and OS/2 workstation or server, or a Windows 95/98 workstation. NETBIOS is part of the Novell

NetWare operating system. For the remote access of a Novell NetWare fileserver the NETBIOS program is not needed.

J.1.1 Loading the GDTMON Program Under NetWare

The GDTMON program for NetWare is part of the ICP System CDROM.
GDTMON can be used either under NetWare 3.1x or under NetWare 4.x. There are two different methods of loading GDTMON:

- loading GDTMON on the fileserver
- loading GDTMON on an authorized workstation (remote)

Loading GDTMON on the fileserver. Beforehand, the ICP NetWare driver (GDTRP311.DSK for NetWare 3.11, GDTRP312.DSK for NetWare 3.12 and GDTRP400.DSK for NetWare 4.x) and the auto-loading module CTRLTRAN.DSK must have been loaded on the fileserver.

```
LOAD  GDTMON <ENTER>
```

on the fileserver.

Loading GDTMON on a workstation. In this case, too, the ICP NetWare driver and the auto-loading module CTRLTRAN.DSK must have been previously loaded on the fileserver console. In addition, the module CTRLSRV.NLM has to be loaded. This module searches for a file named CTRLSRV.CFG. This file must be located in the same directory as CTRLSRV.NLM. The system administrator has to set up a user group named GDT_OPERATOR. All users belonging to this group are given access (through GDTMON) to the ICP Controller(s) in this specific fileserver (Access level 0). Now, the GDTMON program can be loaded from one (or more) workstation(s):

```
GDTMON <ENTER>
```

By selecting the menu *Select Controller* of the GDTMON main menu, you can now choose either a fileserver (equipped with an ICP Controller), or an ICP Controller in your workstation.

J.1.2 Loading the GDTMON Program Under OS/2

The GDTMON program for OS/2 is part of the ICP System CDROM. To load the program under OS/2, enter:

```
GDTMON32  <ENTER>
```

J.1.3 Loading the GDTMON Program Under Windows NT

The GDTMON program for Windows NT is part of the ICP System CDROM. To load the program under Windows NT, enter:

```
GDTMON  <ENTER>
```

J.1.4 Loading the GDTMON Program Under Windows 95/98

The GDTMON program for Windows 95/98 is part of the ICP System CDROM. To load the program under Windows 95/98, enter:

```
GDTMON  <ENTER>
```

J.1.5 Loading gdtmon under SCO UNIX

In order to be able to use the gdtmon program under SCO UNIX (2.x, 4.x and 5.x), it becomes necessary to substitute the standard terminal entry by a new one:

```
cd /usr/lib/terminfo <ENTER>
tic  gdt386.src <ENTER>
```

Before each loading of gdtmon, this terminal has to be activated by:

```
TERM  =  gdt386 <ENTER>
export   TERM <ENTER>
```

These two lines can also be inserted in the ***.profile*** file and will then be automatically processed during each login. The gdtmon program itself is copied during the SCO UNIX installation into the */etc* directory. gdtmon is loaded by entering:

```
gdtmon <ENTER>
```

J.1.6 Loading gdtmon under LINUX

The ICP System CDROM includes two archives:

gdtmon.tgz	GDTMONitor and object files (intel)
gdtmona.tgz	GDTMONitor and object files (alpha)

These archives include all object files to create gdtmon, as well as an executable gdtmon compiled on a current Linux version. If you encounter problems with this executable gdtmon, you can easily compile a new gdtmon on your own Linux system:

unpack the tgz-file:	'tar xvfz gdtmon.tgz'
compile gdtmon:	'make'
start gdtmon:	'./gdtmon'

In order to be able to compile gdtmon you need the C-compiler and the Kernel sources on your system. The link /usr/src/linux has to point to the Kernel sources which correspond with the currently booted Kernel of your system. This is important for "signature.c" to use the right magic for the communication with the driver. Otherwise it may happen that you get "Wrong signature" when trying to start gdtmon.
GDTMON is loaded by entering:

```
gdtmon <ENTER>
```

J.2 The GDTMON Program

As mentioned before, the GDTMON program appears identical for all operating systems, so we can demonstrate the use and functioning of this program regardless of the operating system used. In previous chapters we have already described the hierarchical structure of the ICP firmware. We have defined 4 different levels of hierarchy: Level 1 where the physical devices named **P*hysical* Drives** are found, level 2 containing the ***Logical* Drives** (made up of one or several P*hysical* D*rives*), level 3 where we have the ***Array* Drives**, and finally, level 4 where the ***Host* Drives** are. Only the latter ones are known to the operating system. The drive of a given level of hierarchy is always set up by using the drives of the next lower level as components. Accordingly, GDTMON has various menu options, each referring to one level of hierarchy

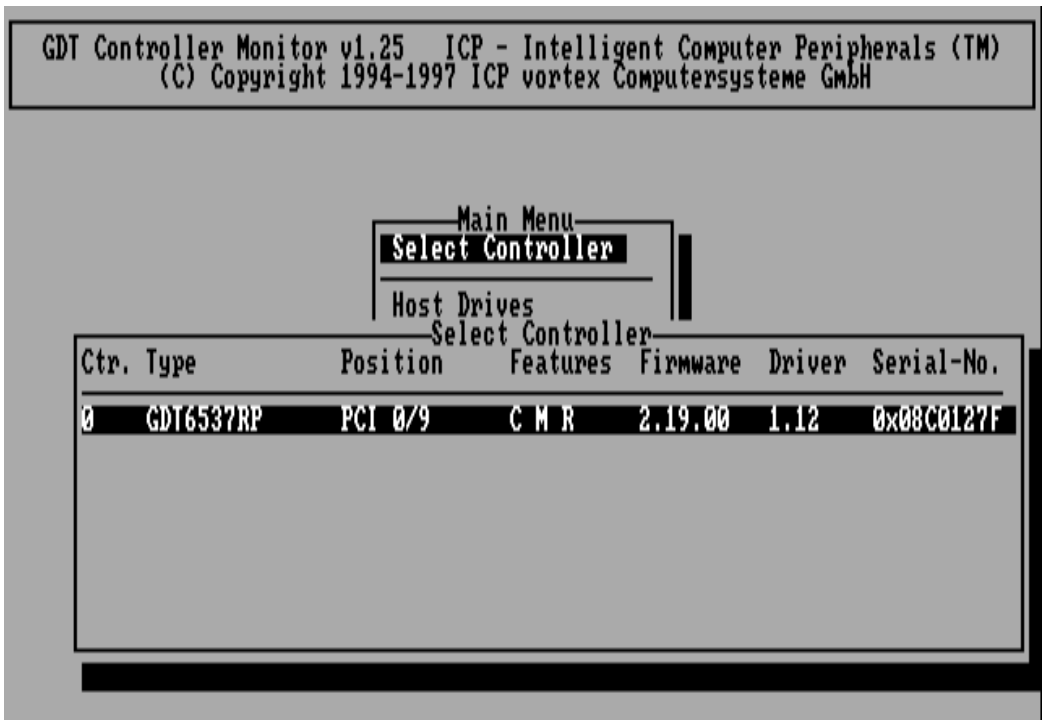
Host Drives	———	Level 4
Logical Drives	———	Level 2
Physical Drives	———	Level 1

Each menu option displays the performance of the drives belonging to the corresponding level. (Note: The performance of Array Drives and Host Drives is identical). The performance is measured in KB/s (kilobyte per second, transfer rate) and IO/s (I/Os per second, number of simultaneously processed I/Os on the ICP Controller). The performance is displayed numerically as well as graphically in the form of variable horizontal bars, with separate indications for each drive and its write and read accesses.

J.2.1 Select Controller

This menu option yields a list of available ICP Controllers. By selecting a protocol, you have either access to the ICP Controller(s) in your local computer (e.g., MS-DOS, Windows NT, Windows 95 or OS/2 protocol), or to an ICP Controller in another computer (server or workstation) in the network (NetWare NCPE or IBM NETBIOS protocol). All diagnosis and maintenance functions of GDTMON refer to the ICP Controller you have selected here (and the hard disks connected with this controller).

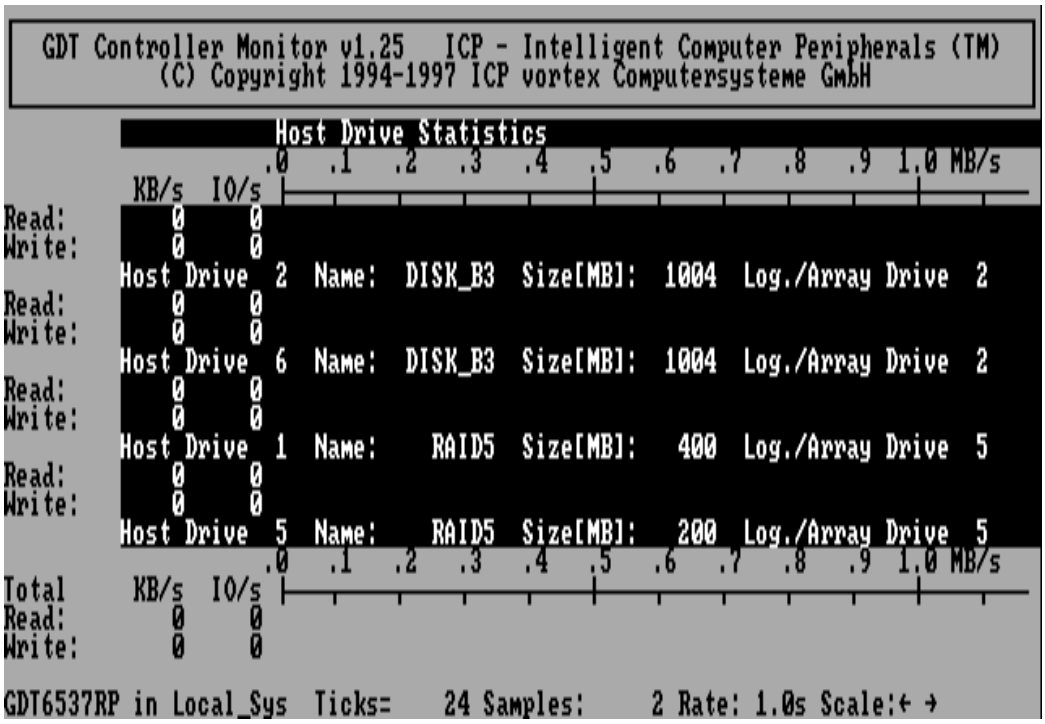
(MS-DOS) in the Select Protocol menu indicates that the GDTMON program was loaded on a MS-DOS computer. I.e., if GDTMON had been loaded under Windows NT, we would see there (Windows NT).



J.2.2 Host Drives

This menu option leads to the list of available Host Drives (level 4). We would like to recall that the operating system (e.g., NetWare) only recognizes these Host Drives and not their possibly complex structures. This means that it is of no importance for the operating system if a Host Drive consists of one single hard disk (of the type *disk*), or of 5 hard disks con-

figured to form a RAID 4 Array Drive. Apart from the performance, the name, type, state and capacity (1024KB = 1MB) of a Host Drive is displayed. The figures shown at T*otal* represent the overall performance of the Host Drives as a whole. With the ← and → keys you may change the scale of the graphical KB/s indication. With the ↑ and ↓ keys you can scroll the screen to see further Host Drives (if available).



(Note: All Host Drives on the screen shown above are idle.)

J.2.3 Logical Drives

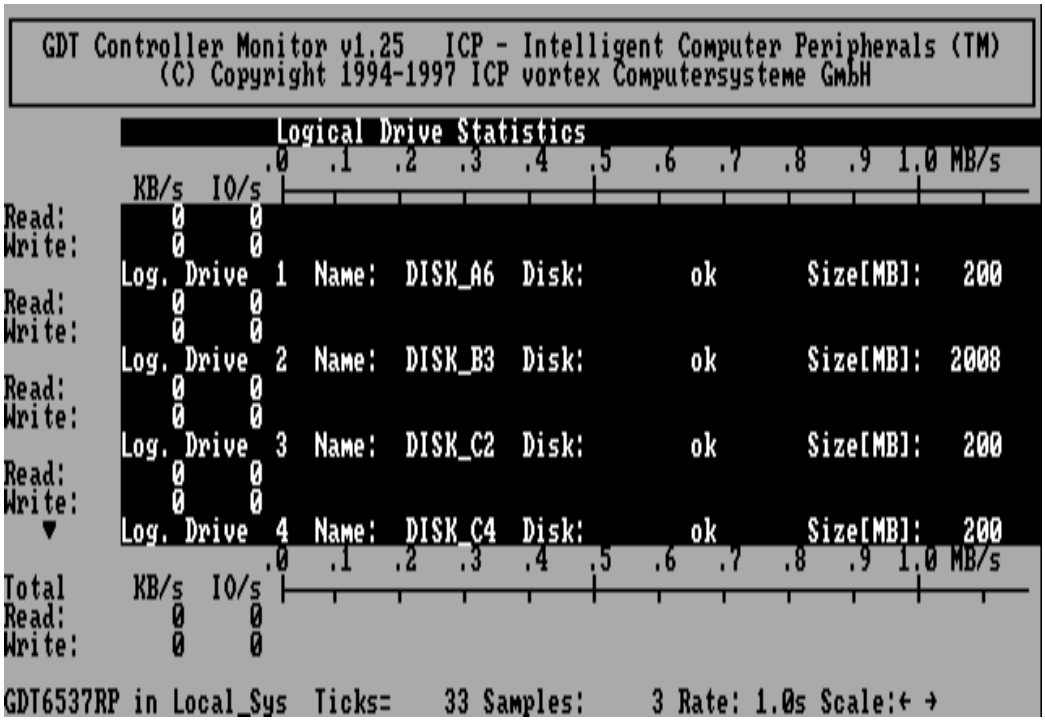
This menu option yields a list of available Logical Drives (level 2). Logical Drives are the components for Array Drives and Host Drives. In its most simple form, a Host Drive consists of one Logical Drive which is made up of a single hard disk (type *disk*). In case of RAID Host Drives, the performance of the Logical Drives forming a RAID Host Drive are shown in the menu L*ogical* D*rives*. The performance data displayed here gives immediate information on the quality of a given Host Drive. When judging the indicated performance of Logical Drives belonging to a RAID Host Drive, the following considerations should be taken into account:

(a) RAID 0, RAID 1, RAID 10 and RAID 5 Host Drives
If a certain Logical Drive shows poor performance for a longer period (when compared to the other Logical Drives), this Logical Drive impairs the overall performance, making it the *bottle neck* of the entire RAID Host Drive.

(b) RAID 4 Host Drives
In principle, the same as in (a) applies to RAID 4 Host Drives, with the exception made for the parity Logical Drive. The poor performance can have various reasons: the hard disk forming the Logical Drive

- is too slow (different from the other hard disks with regard to type or manufacturer)
- has wrong parameters (SCSI II, disk cache, tagged queues etc.)
- has too many defects, causing the read/write actuator to have to move to *alternate tracks* very often

When setting up RAID 4/5 Host Drives, please observe the notes on RAID 4/5 Host Drives exposed in the chapter **GDTSETUP in Detail**.



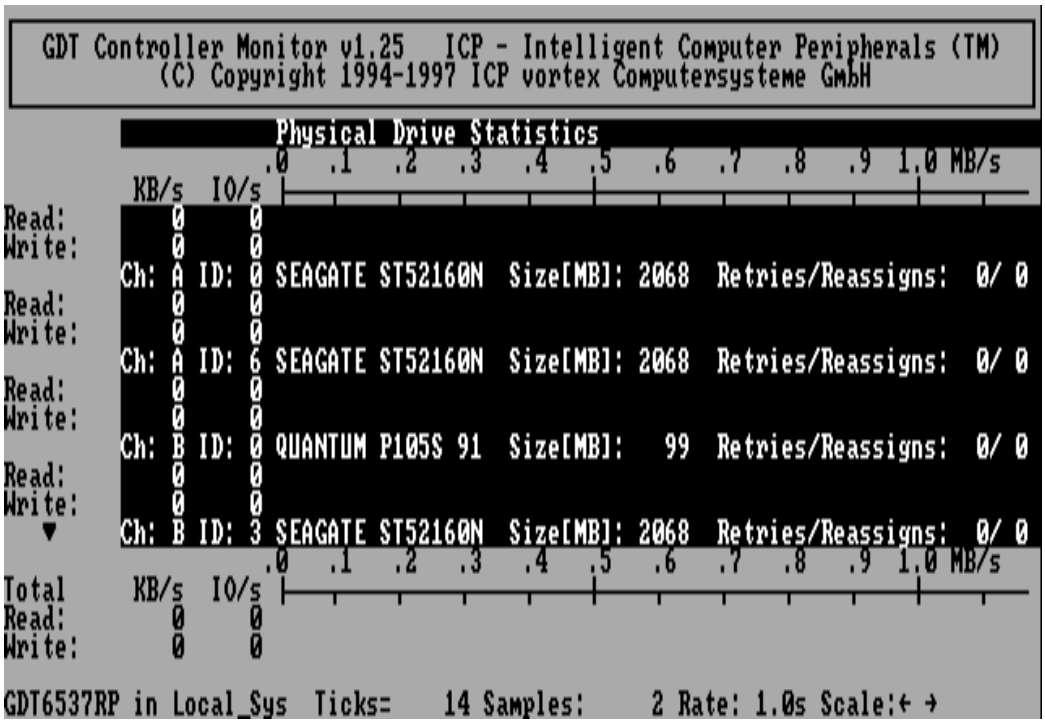
The figures under T*otal* represent the total performance of all Logical Drives. With the ← and → keys you may change the scale of the graphical KB/s indication. With the ↑ and ↓ keys you can scroll the screen to see more Logical Drives (if available).

J.2.4 Physical Drives

In addition to the performance report on the hard disks, you are given additional information on each device:

- the ICP I/O channel the hard disk is connected to
- which ID the hard disk has
- the name of the hard disk

- the gross capacity (1MB = 1024KB)



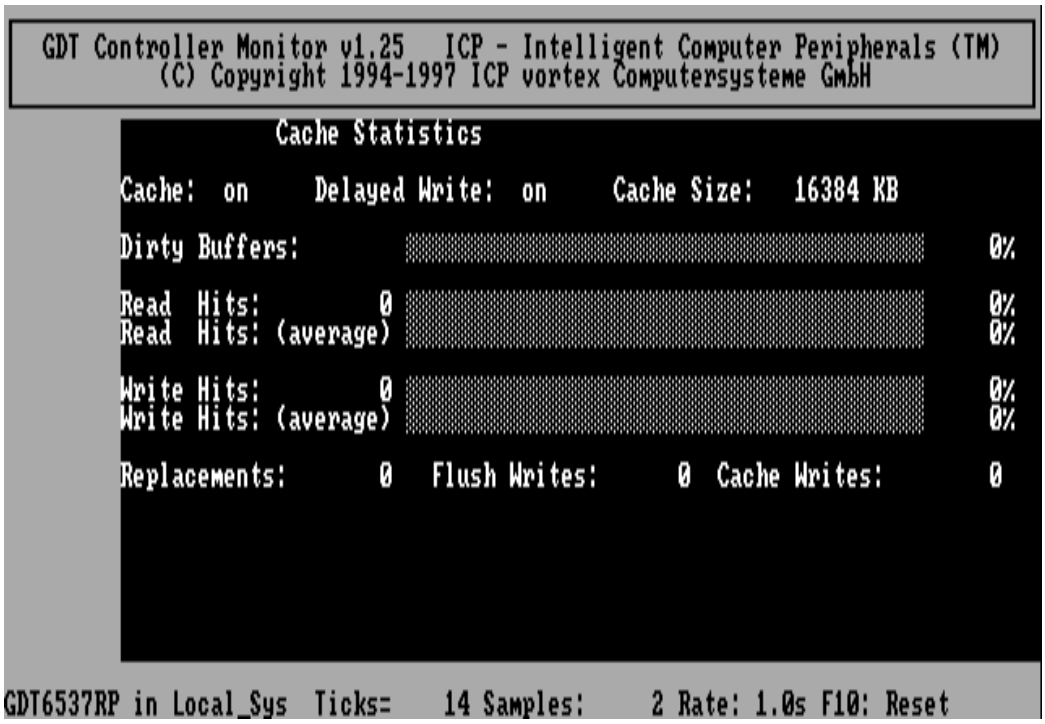
The R*etries*/R*eassigns* counters have a particular meaning:

(1) The R*etries* counter is incremented by one unit whenever the ICP Controller retries to access a hard disk. If this counter continues to increase (possibly on other hard disks, too) it is very likely that the cable is not *good* enough for the selected data transfer rate (cable too long, poor quality of cable and connectors), or that the SCSI bus is not properly terminated (too many terminators on the cable, or missing terminator). In very few cases is the hard disk concerned defective. The retry counter also increases when the SCSI parameters of a hard disk are changed (see further ahead). Obviously, retries due to this do not imply bad cabling.

(2) The reassign counter reflects the number of media defects which occur on the hard disk drive. Defective blocks of the hard disk are assigned substitute blocks (spare blocks) which are either on the same track, or on alternate ones if all spare blocks on the same track are already in use. The administration of the reassignments is carried out by the hard disk through according reassignment tables. Note: If a hard disk works with alternate tracks, it is generally no longer suitable for applications with high performance expectations. Whenever a defective block is being accessed, the read/write actuator has to move to an alternate position and this requires extra time.
If you observe that the number of reassigns is constantly increasing, you may suspect that something is wrong with this drive.
With the ← and → keys, you can change the scale of the graphical KB/s indication.
With the ↑ and ↓ keys, you can scroll the screen to see more hard disks (if available).

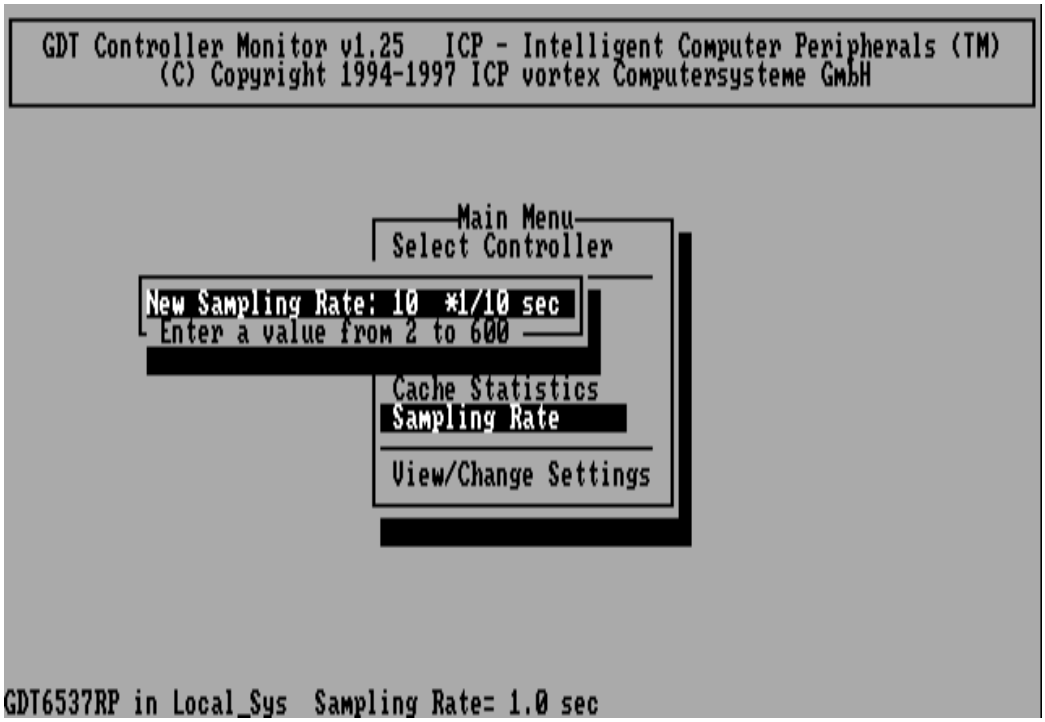
J.2.5 Cache Statistics

This menu option gives information on the utilization of the ICP cache. For RAID 4/5 Host Drives, the data cache and parity cache are displayed separately.
Note: The ICP firmware only allocates cache RAM to the ICP parity cache if RAID4/5 Host Drives have been set up.



J.2.6 Sampling Rate

By setting the sampling rate, you can choose the interval at which the ICP Controller delivers new measurements. According to the operating system used, the sampling rate can be set to a maximum of 60 seconds. The default setting is 1 second.



J.3 The Menu: View/Change Settings

This menu includes a set of very powerful options and functions for the online maintenance and diagnosis of RAID 1/4/5/10 Host Drives.

From this menu you can select further submenus:

Controller - View the ICP Controller configuration
- View Last Events
- View/Change the Intelligent Fault Bus settings

Cache Settings - View/Change the ICP cache parameters

Physical Drives - View/Change the SCSI parameters

Logical Drives - Display the structure of Logical Drives
- Add/Remove Mirror Drives to/from Host Drives
- Perform a Hot Plug on a RAID 1 Host Drive
- Add/Remove Private Hot Fix and Pool Hot Fix drives to/from a RAID 1 Host Drive

Array Drives - Display the structure of RAID 4/5/10 Host Drives
- Perform a Parity Verify on RAID 4/5 Host Drives
- Perform a Parity Recalculation on RAID 4/5 Host Drives
- Perform online capacity expansion and/or RAID level migration
- Perform a Hot Plug on RAID 4/5/10 Host Drives
- Add/Remove Private Hot Fix and Pool Hot Fix drives to/from RAID 4/5/10 Host Drives

Save Information - Save all relevant configuration data to disk

Before going into detail, some information on the so-called Hot Plug of fault tolerant disk arrays (RAID 1/4/5/10) is given below.

J.3.1 Notes and Information on the Hot Plug function of GDTMON

Fault tolerant means that a hard disk which is part of a RAID 1/4/5/10 Array Drive can fail without causing data loss on the Array Drive. At the same time, the Array Drive remains fully accessible. Obviously, the Array Drive then lacks the redundant data, therefore the defective disk should be replaced by an intact one as soon as possible. In chapters C (RAIDYNE *Quick-Setup*) and in the addendum (GDTSETUP *in Detail*), we have shown with various examples how to exchange a defective drive with GDTSETUP. Moreover, we described the functioning of the so-called Hot Fix drive. This "constantly available spare part when needed" automatically integrates itself into the Array Drive and is therefore the quickest means of regaining a redundant Array Drive.
The Hot Plug function enables the replacement of a drive of an Array Drive (either in the *ready* or *fail* state) while the system continues to run, that is, without having to shut down the NetWare fileserver for instance. A drive replacement may not only become necessary when the drive has already failed, but also when there are signs that a failure could occur soon (strong whistling of the hard disk, or constant retries of the read/write head).
Only those users with thorough knowledge of RAID and the ICP Controller should use the Hot Plug function. Improper use can lead to data loss. (Naturally, we have integrated all kinds of security provisions into the ICP Controller and GDTMON. But how can we prevent a user from plugging out the wrong drive?). We recommend that you document each Array Drive immediately after its configuration with GDTSETUP. This record should at least comprise the following information:

- To which ICP Controller has the Array Drive been connected ?
- Which hard disks are part of the Array Drive ?
- To which SCSI ID have they been set ?
- Which SCSI devices terminate a SCSI channel ?

In addition, the hard disks themselves should be labeled with the above information. The following is an example of such a label.

C xy z t

C: controller number ***x***: channel
y: ID ***z***: Logical Drive number
t: **+** = terminated, **-** = not terminated (with SCSI hard disks)

Example:

1 SCSI-A 6 3 +

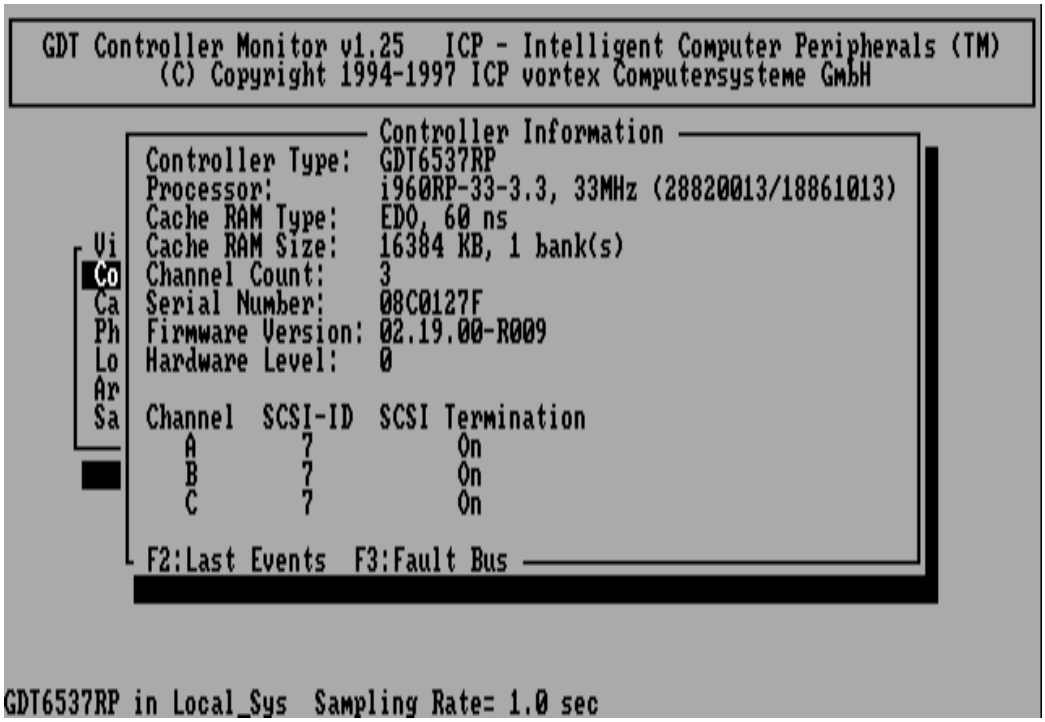
controller number 1, SCSI channel A, SCSI-ID 6, Logical Drive number 3, terminated. The menu option *Save Information* of GDTSETUP, GDTMON program can be of help when setting up the documentation.

How does the Hot Plug mechanism work ?

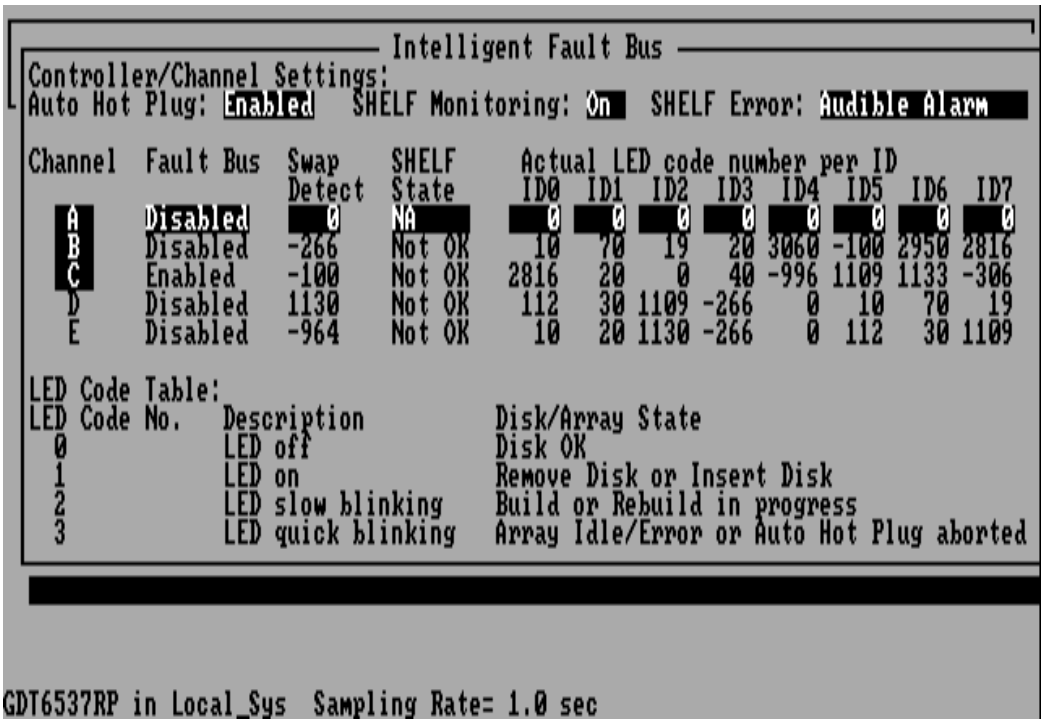
During the Hot Plug, the I/O channel of the ICP Controller to which the drive to be exchanged is connected, is temporarily "halted" (for the time needed for the exchange), so that the drive can be disconnected from the I/O channel and replaced without any risk. After the replacement, the I/O channel halt is lifted and the firmware automatically begins to rebuild the new drive. The halting and the halt-lifting of the I/O channel is controlled by the Hot Plug function. The Hot Plug should be carried out as quick as possible.

J.3.2 Controller

This option displays details on the ICP Controller. For example, how much Cache RAM the ICP Controller has and what the current termination setting of the SCSI channel is.



Press <F3> to get detailed information on the configuration of the Intelligent Fault Bus (IFB). Changing and enabling these features requires the existence of an IFB-compatible subsystem.

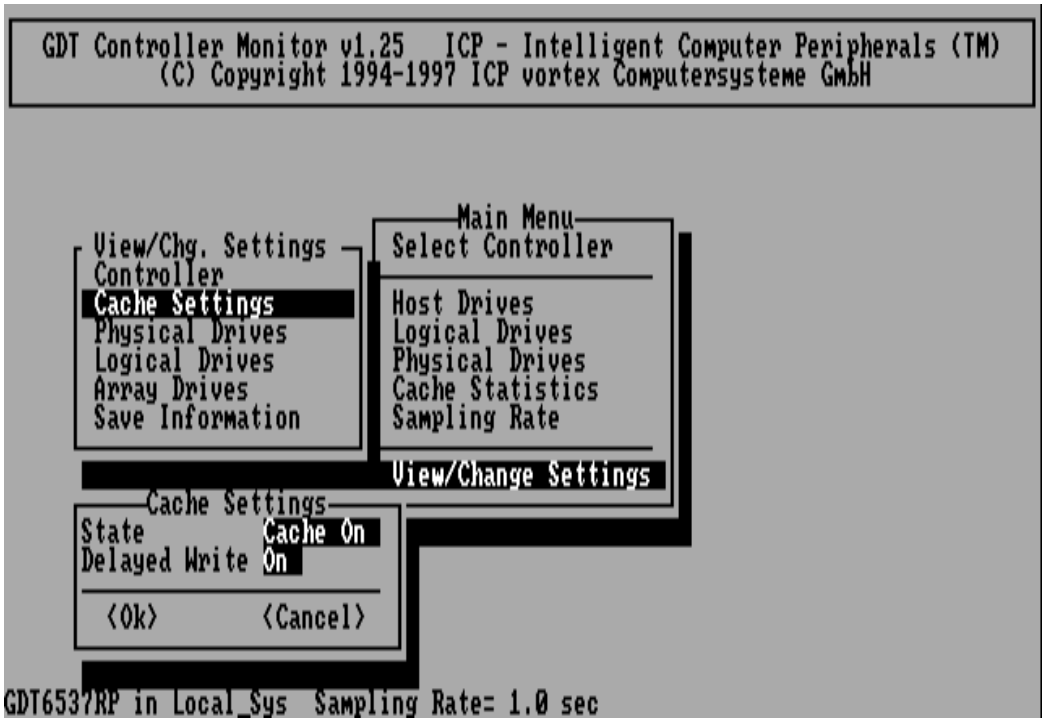


J.3.3 Cache Settings

This submenu displays the current ICP cache settings which can be changed here. The various settings are:

Cache ON	the ICP cache is enabled, that is, all accesses to the Host Drives pass through the ICP cache
Cache OFF	the ICP cache is disabled
Delayed Write ON	Write accesses are delayed, i.e., the write-back cache algorithm is active
Delayed Write OFF	All write accesses are directly transmitted to the Host Drives. If delayed-write is off and the Cache is ON, the ICP cache works exclusively as a read cache.

Note: Best performance is achieved with *Cache* ON and *Delayed Write* ON.

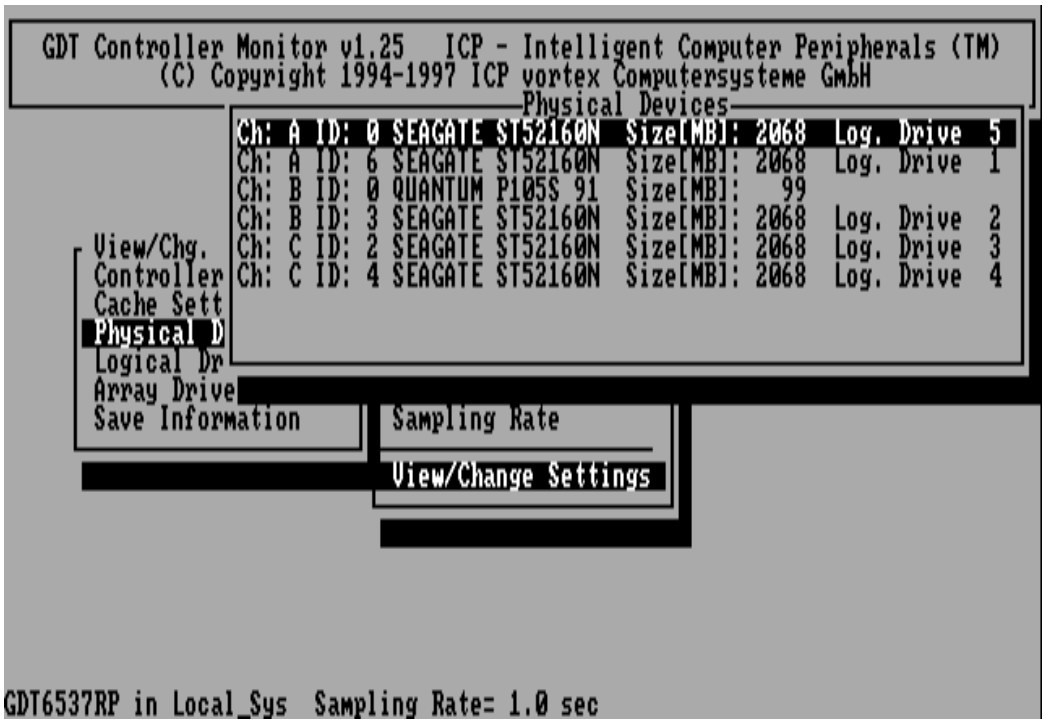


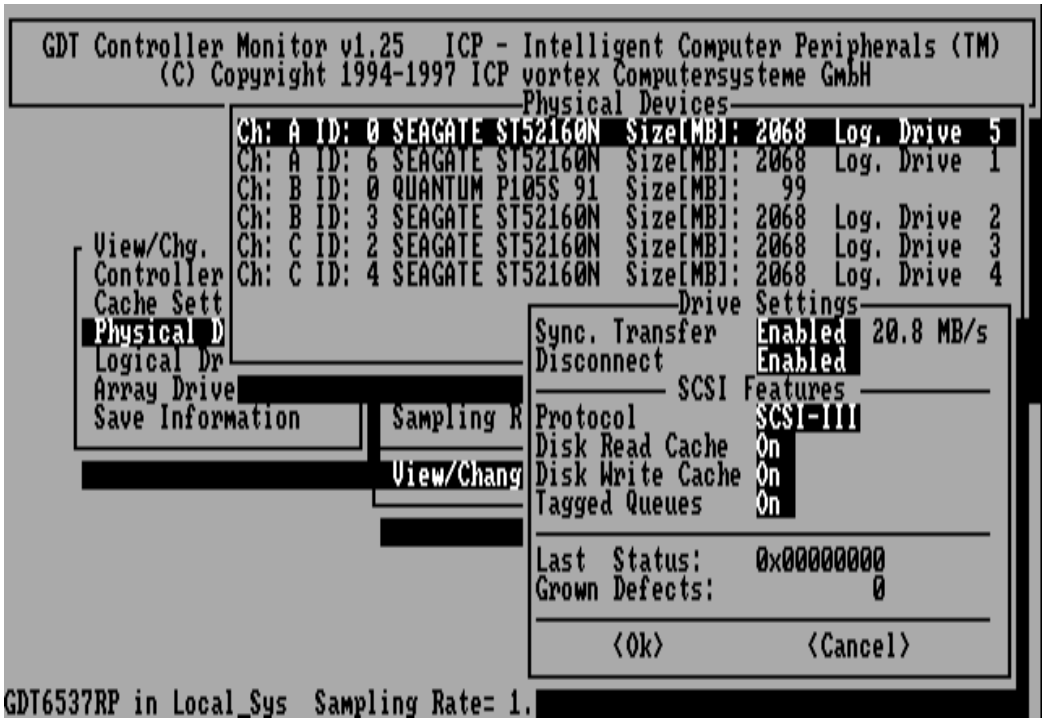
J.3.4 Physical Drives

This option gives a list of all hard disks connected to the ICP Controller. Besides information on the ICP I/O channel, the ID, the name/vendor and the gross capacity (1MB = 1024KB), it also shows which hard disk(s) belong to a given Logical Drive.
When you select a hard disk in this list and then press <ENTER>, GDTMON gives you further information on the *Drive Settings* of this device. These settings may be changed.

The Last Status information should always be 0x00000000. After a device failure or other significant events, a different value may be displayed here.

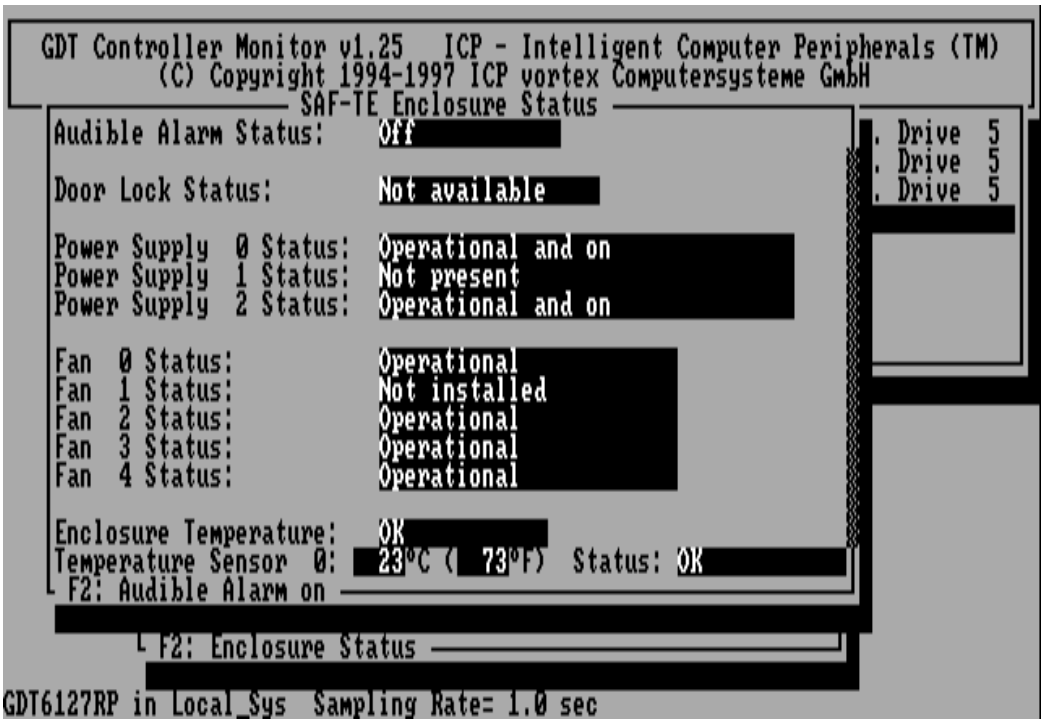
The Grown Defects counter shows the number of media defects which have occurred since the first time the device was operated with an ICP Controller. A specific hard disk is in a good condition when it has 0 grown defects. When this counter increases, there is definitely something wrong with the device.





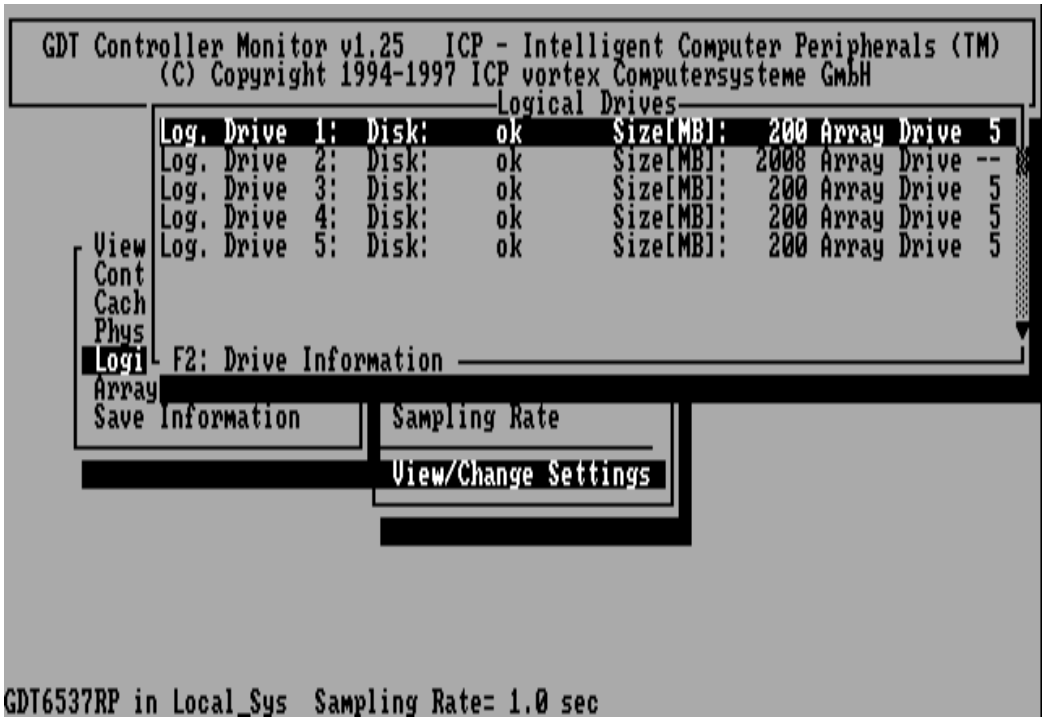
If you select the SEP of a SAF-TE subsystem, GDTMON displays a list of the installed and configured slots in the subsystem

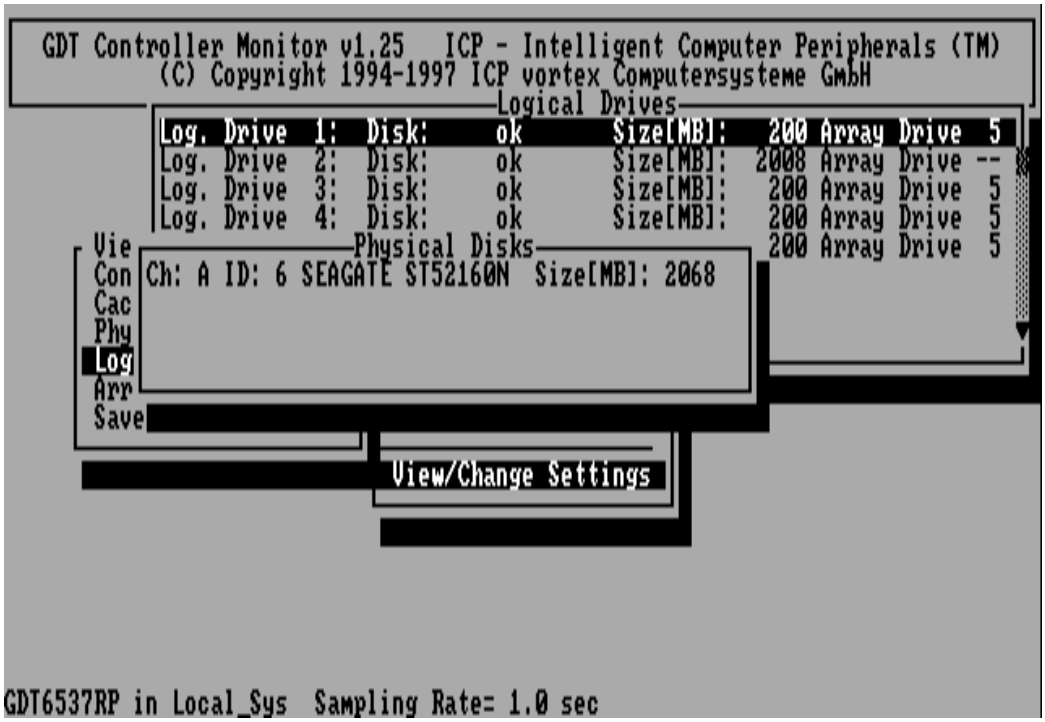
Press <F2> to get the status of the SAF-TE enclosure.



J.3.5 Logical Drives

This command yields a list of the existing Logical Drives. In addition to the Logical Drive numbers, information on the drives' type, state, net capacity and belonging to a given Array Drive / Host Drive is displayed. Press <F2> to obtain further information on a selected Logical Drive.





Press <ENTER> to select a Logical Drive. The following options become available:

J.3.5.1 Set Logical Drive Name

Change the name of the Logical Drive. This name was defined within GDTSETUP, either automatically, or manually.

J.3.5.2 Hot Plug: Replace Mirror Drive

If a RAID 1 or RAID 10 Host Drive has already been set up, a defective drive can be replaced (Hot Plug) while the system continues to be fully operational.

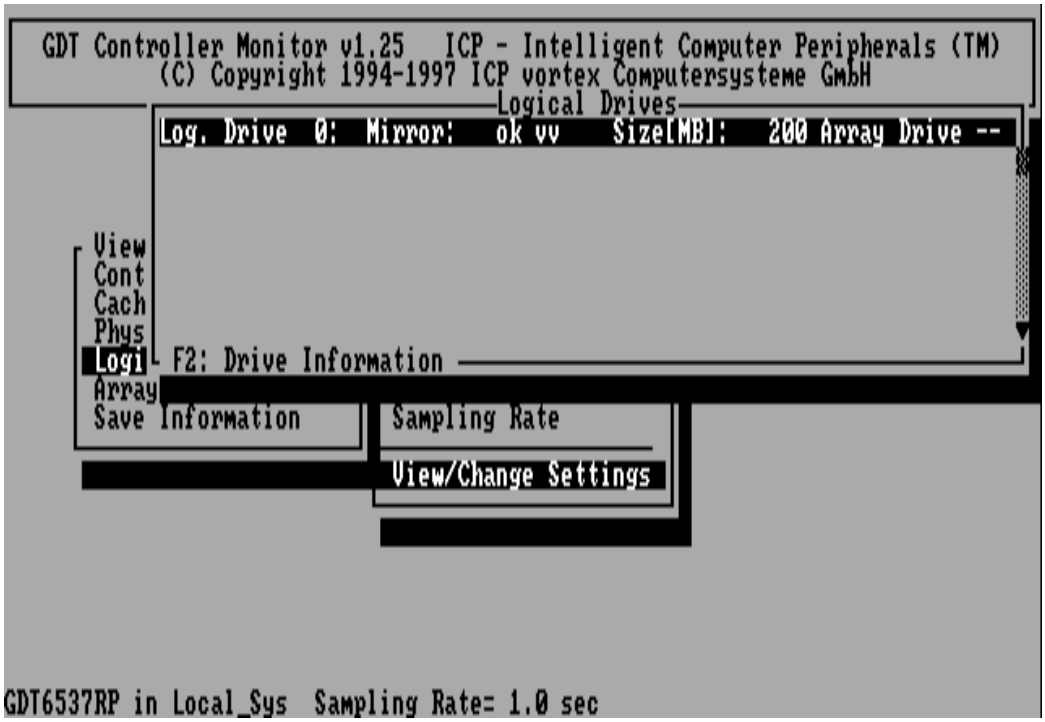
There are typically two different applications, where a Hot Plug becomes necessary.

Application 1. The RAID 1/10 Array Drive is in the fault tolerant (both drives are valid: *vv*). It is likely that a drive will fail soon (for example when there is a loud operating noise). As a preventative measure, this drive ought to be exchanged now, that is, in a moment when the Array Drive is still in a ready state and still has redundancy.

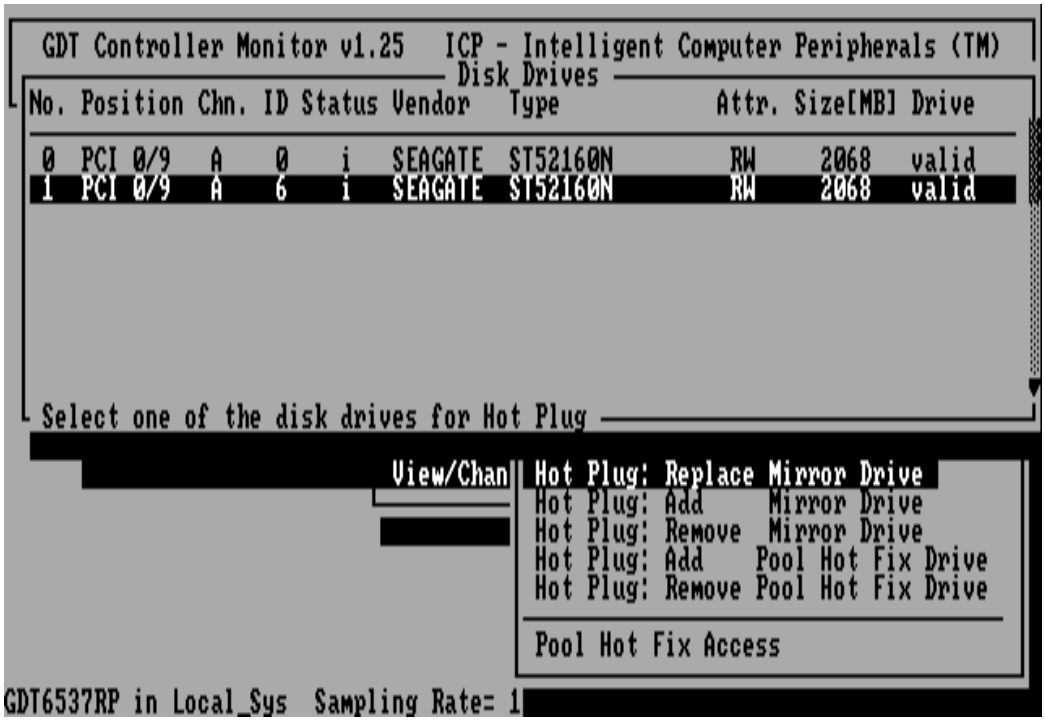
Application 2. The Array Drive is no longer fault tolerant, because a drive of the Array Drive has actually failed. The Array Drive is still fully operational, but it does not have redundancy any more. If another drive should fail, too, the Array Drive's functionality is impaired.

Example Session for Application 1

We assume that there is a RAID 1 Array Drive which is fault tolerant. Its state is *vv*, both Logical Drives are valid. After selecting the Array Drive, we choose the Replace Mirror Drive option.

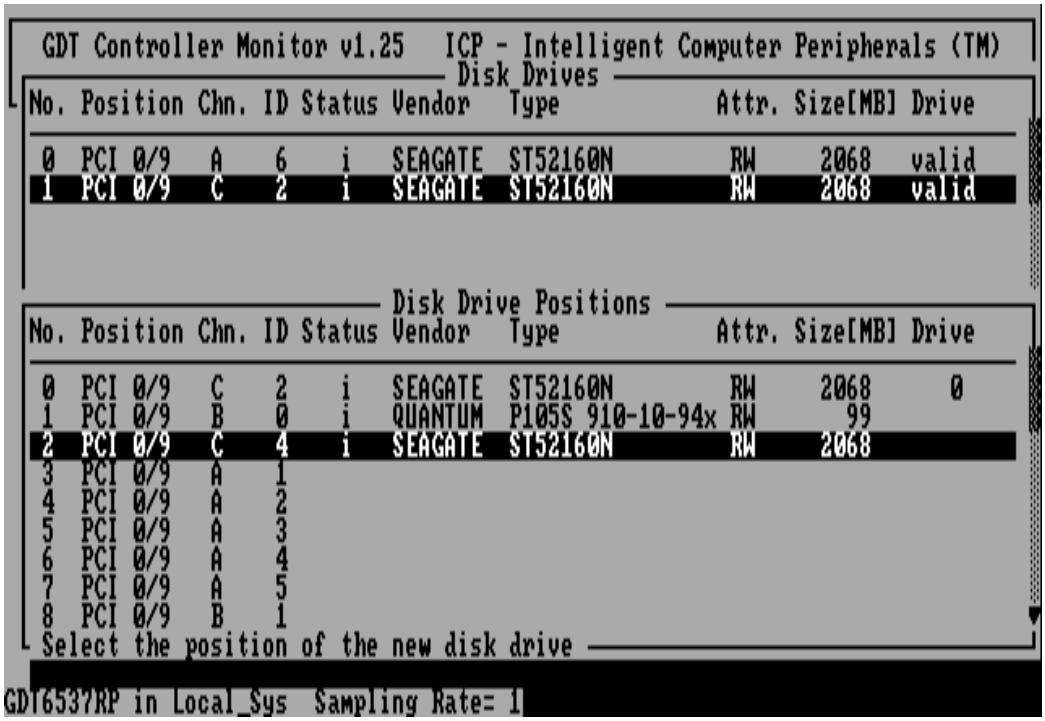


A list is displayed which shows the members of the RAID 1 Array Drive.



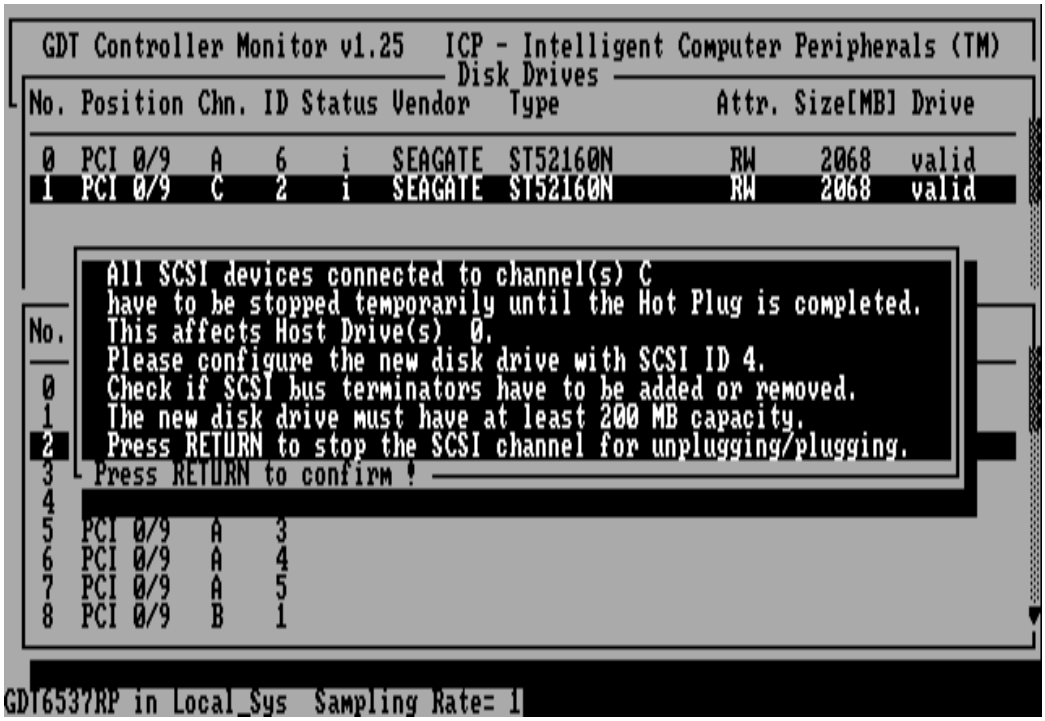
The Hot Plug function now displays a list of the positions available for the new drive. Each position is univocally determined by its coordinates (I/O channel, ID).Obviously, the new drive can only be assigned to a position which is not occupied by another device yet, exception made for the position still occupied by the drive to be exchanged.

We choose entry number 1 and press <ENTER>.

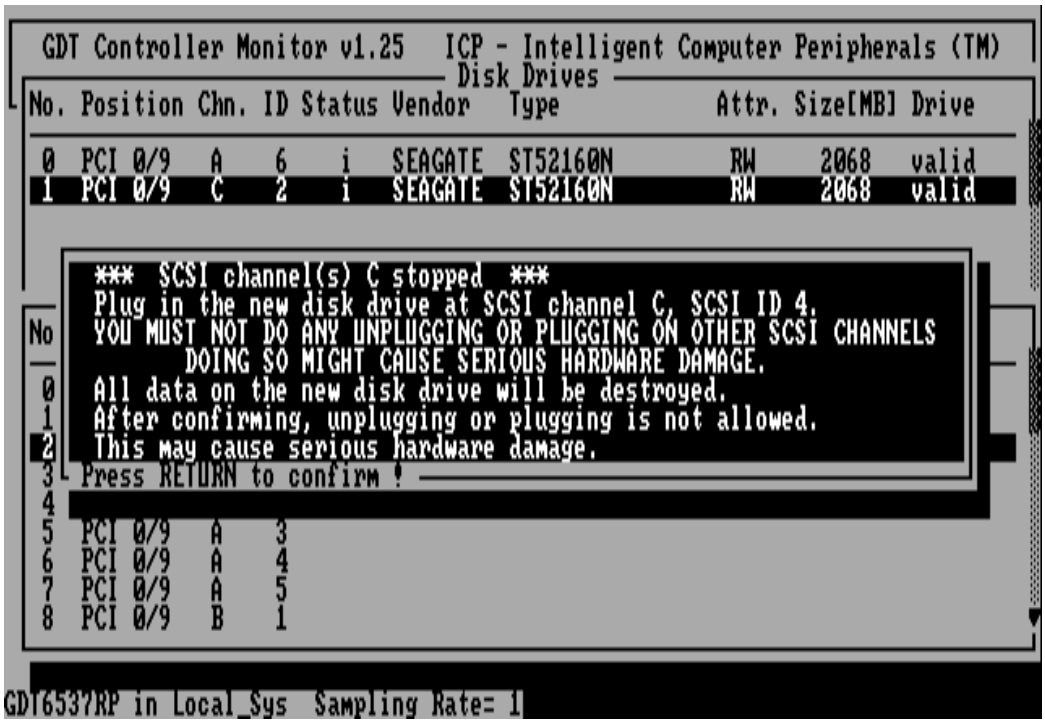


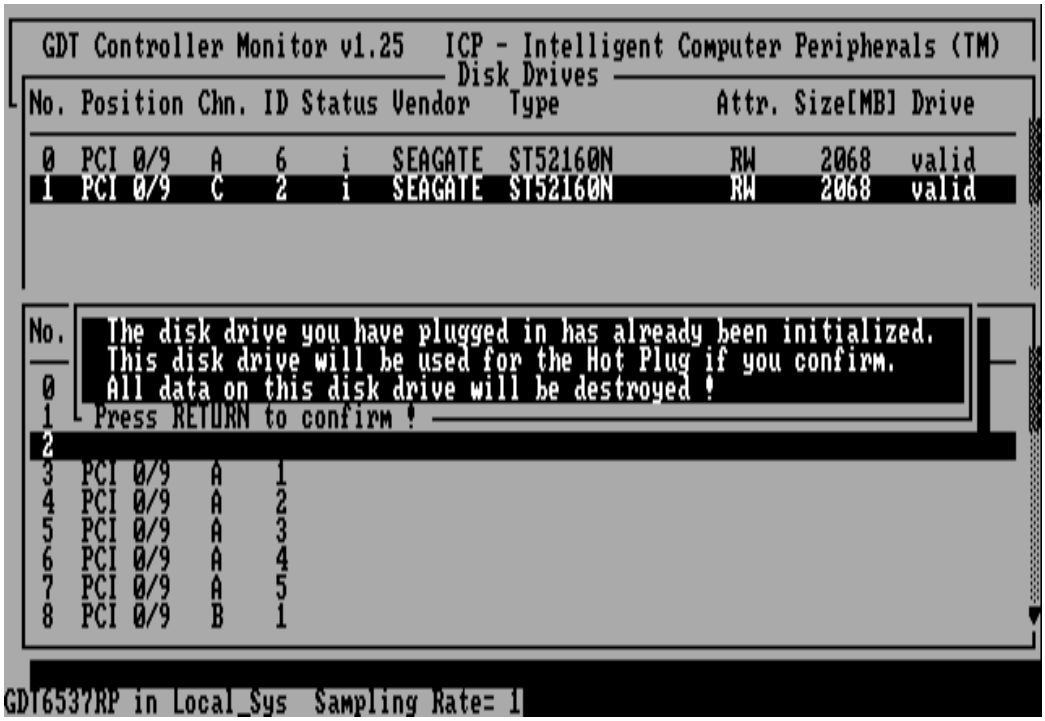
For this example, we select the first position and receive the following message:

The Hot Plug function now informs us that all devices on the I/O channel to which the drive to be exchanged is connected, have to be temporarily halted. In addition, it shows which Host Drives are affected by this brief halt. With regard to the new drive, we are given some important information: Required storage capacity, ID and possible SCSI bus termination. The <ENTER>-key may only be pressed when the new drive is ready at hand and after having checked its capacity, ID and SCSI termination (the latter two may have to be changed). In our example we presume that these preparations have been made, so we press <ENTER> in order to halt the I/O channel.



Now we have entered the actual Hot Plug procedure. Disconnect the drive to be exchanged by plugging it off from the I/O channel first, and then, from the power cable. We immediately connect the new drive to the plugs that are now free, first to the power supply and then to the I/O channel. After having reconnected the new drive properly, press <ENTER>.



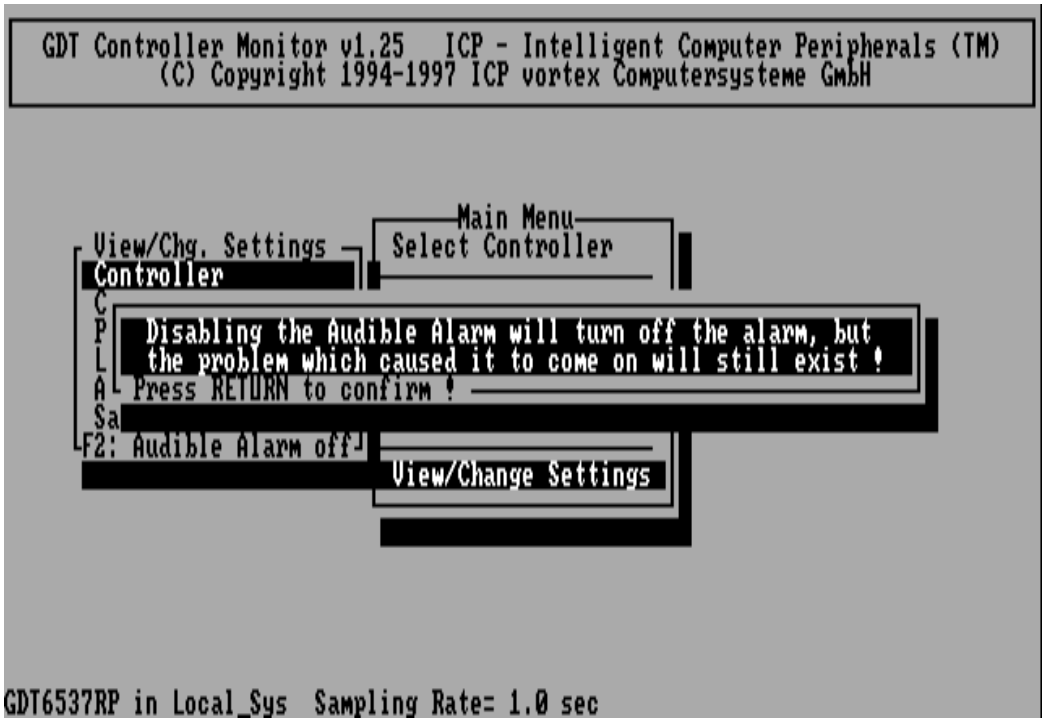


GDTMON recognizes that the new hard disk was already initialized before. Confirmation of this message destroys all data on the selected drive.

After this confirmation, the Hot Plug is finished successfully. It takes approximately 10 minutes to re-synchronize the data with this sample configuration.

Example Session for Application 2

We assume that there is a RAID 1 Array Drive which is no longer fault tolerant. Its state is -1/*v*, one drive has failed and is therefore no longer accessible on the I/O channel.
The ICP Controller started beeping. The audible alarm can be disabled within GDTMON by pressing <F2> as soon as the View/Change Settings menu is loaded:



After selecting the Array Drive, we choose the Replace Mirror Drive option.

Before the new drive can be added, the missing drive has to be deleted in the RAID 1 configuration.

After confirming here with "Yes", you can follow the next paragraph "J.3.5.3 Hot Plug: Add Mirror Drive", to add a new mirror drive to the remaining drive out of the previously failed RAID 1 Array Drive.

J.3.5.3 Hot Plug: Add Mirror Drive

This option allows you to add another Logical Drive as a mirroring drive to another Logical Drive. The new hard disk can be plugged onto the I/O channel while the system continues to be fully operational. If a spare and suitable hard disk is already connected and not yet

assigned to a Logical Drive or Host Drive, it will be displayed in the list of Disk Drive Positions.
There are two cases which make this function very interesting:

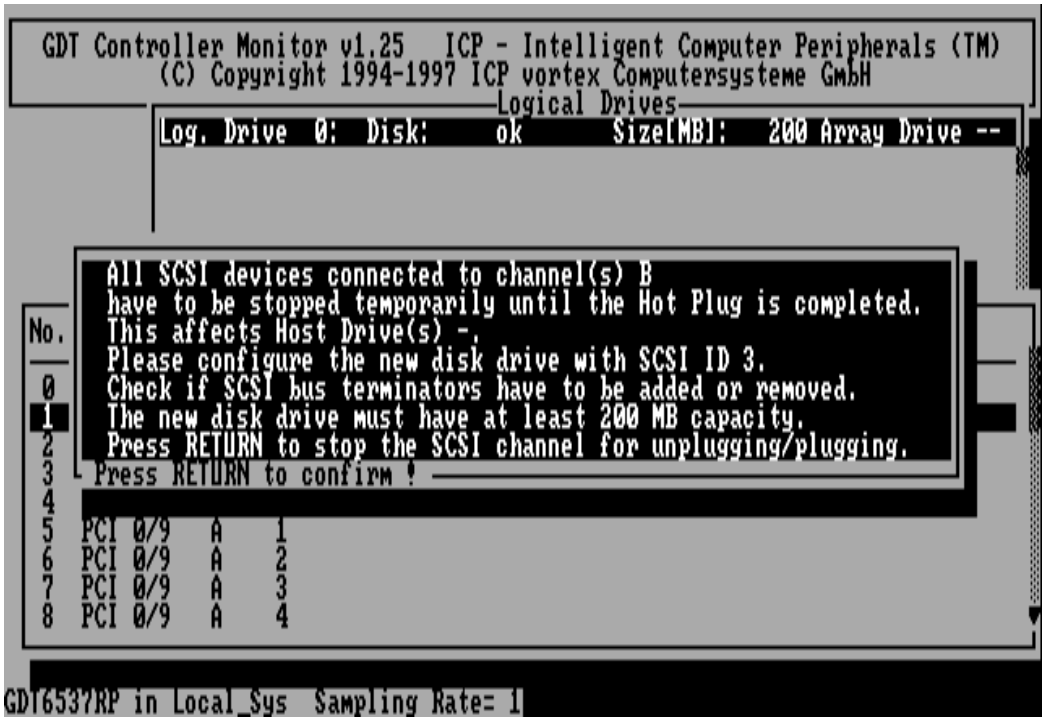
1. An existing hard disk should be given 100% redundancy, but there is no time to shut down the system and interrupt the normal operation

2. An existing hard disk has a high probability of failure, because it makes, for example, a strange noise or generates a lot of grown defects, but there is no time to shut down the system and interrupt the normal operation.

Once the new hard disk is added, the data synchronization (mirroring update) is automatically carried out in the background simultaneously with the normal operation.

In this example, there was already a spare hard disk available (on Channel B, SCSI ID 3). This drive must not be a Logical Drive. Otherwise it will not be available for this function.

After selecting the new hard disk, the following message appears:



The following message indicates that channel B was stopped for the time of the actual Hot Plug.

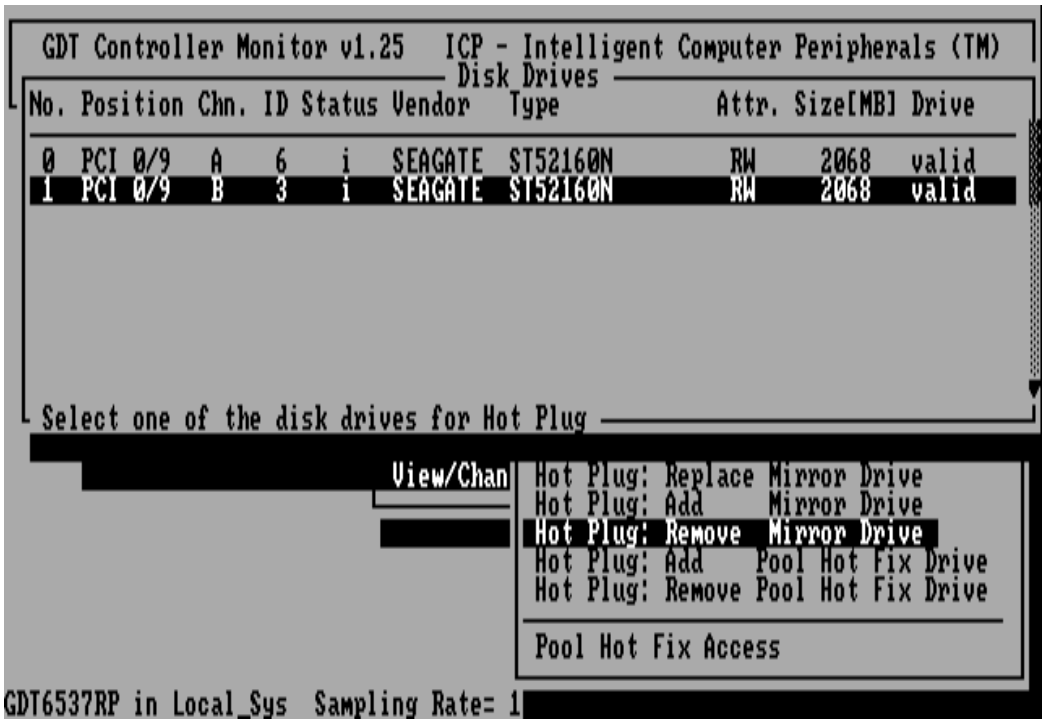
Now, the new hard disk is added as a mirror to the selected Logical Drive. The updated list of available Logical Drives shows the change. The Logical Drive changed its type to M*irror* and the data on the new hard disk are currently synchronized, indicated through the "*" behind the "v".

After pressing <F2>, the new structure is displayed.

The entry "invalid" for the second drive means that the data have not yet been (completely) copied from the first drive. After the completion of the synchronization process, this entry changes into "valid".

J.3.5.4 Hot Plug: Remove Mirror Drive

This option allows the removal of a Mirror Drive from a RAID 1 or RAID 10 Array Drive. Once the drive has been removed, the data on the other drive are no longer redundant.

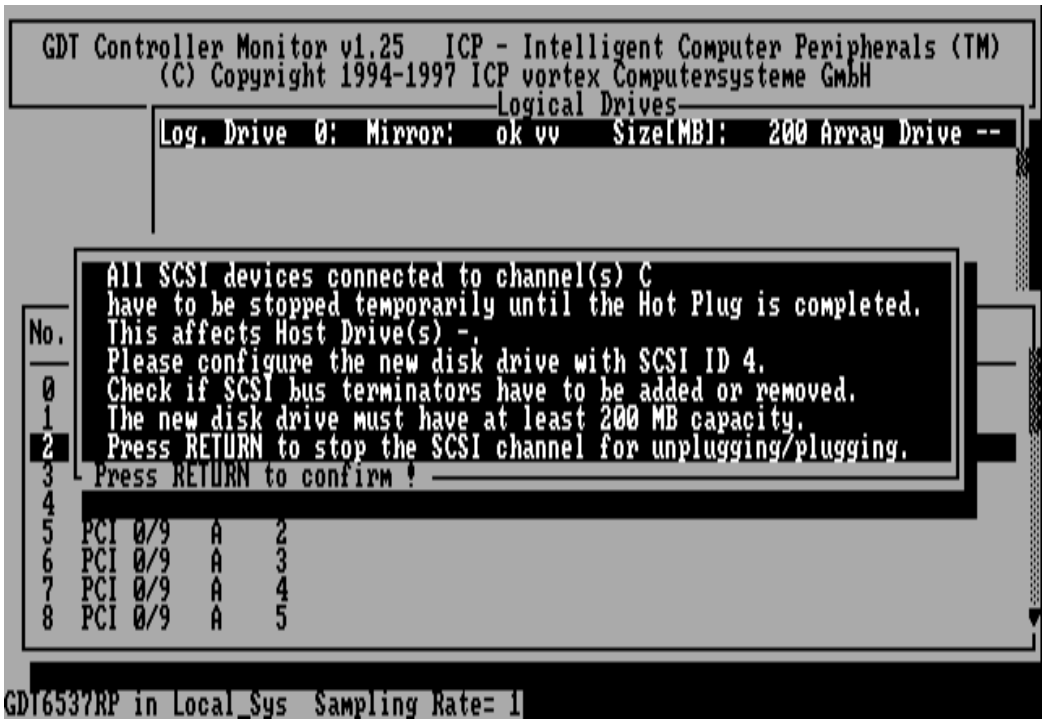


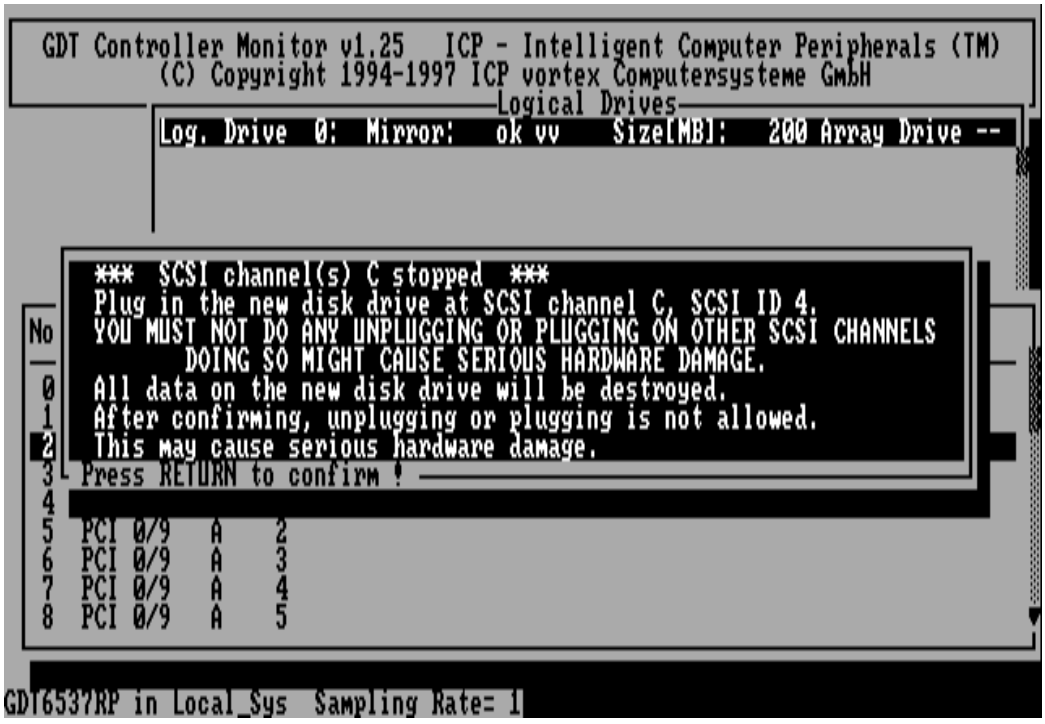
J.3.5.5 Hot Plug: Add Pool Hot Fix Drive

A Pool Hot Fix Drive is a spare drive within the so-called Hot Fix Pool. A drive in a Hot Fix Pool is available for several RAID 1 and RAID 10 Array Drives as a Hot Fix drive. Thus, several Array Drives can share one Hot Fix drive. Of course, once this drive has been used by one of the Array Drives, it is no longer available for the others.

After selecting this option, GDTMON scans the ICP Controller for drives which are suitable

for becoming a Pool Hot Fix drive (i.e. they belong to no Logical Drive), and for free coordinates (SCSI Channel / SCSI ID). We choose Channel C and SCSI ID 4 for the new Hot Fix Drive.

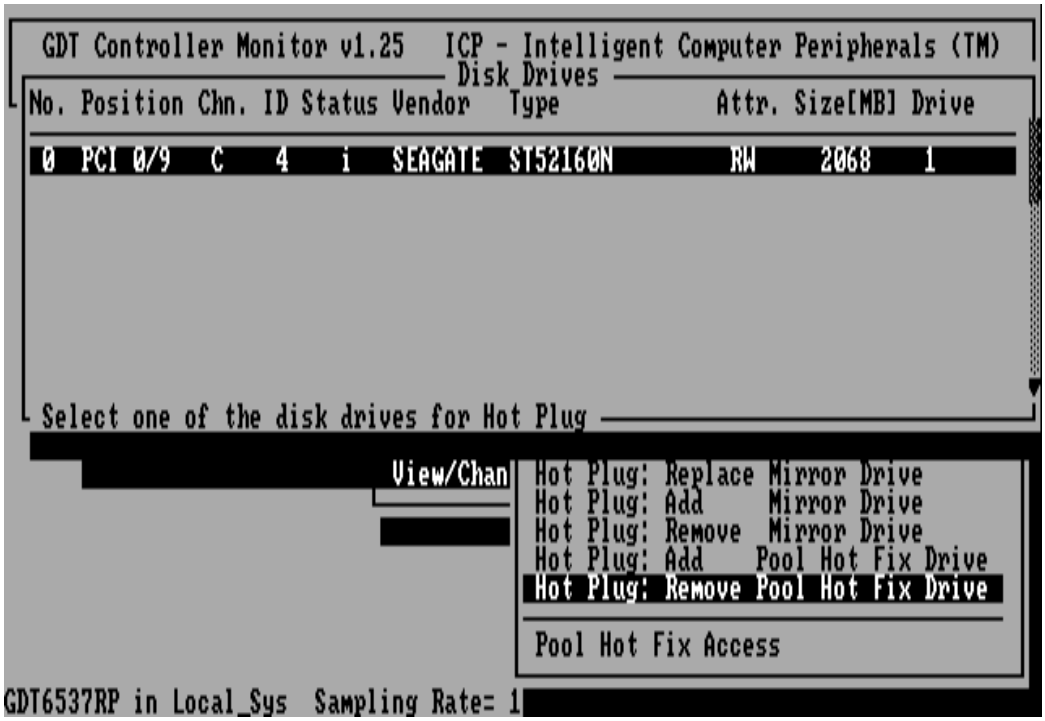




After the completion of this function, the Pool of Hot Fix drives contains a new drive (in our example here, it is the only drive.
To allow a RAID 1 or RAID 10 Array Drive access to the Hot Fix Pool, use the Pool Hot Fix Access menu (J.3.5.7).

J.3.5.6 Hot Plug: Remove Pool Hot Fix Drive

It may become necessary to remove a certain drive from the Hot Fix Pool.



J.3.5.7 Pool Hot Fix Access

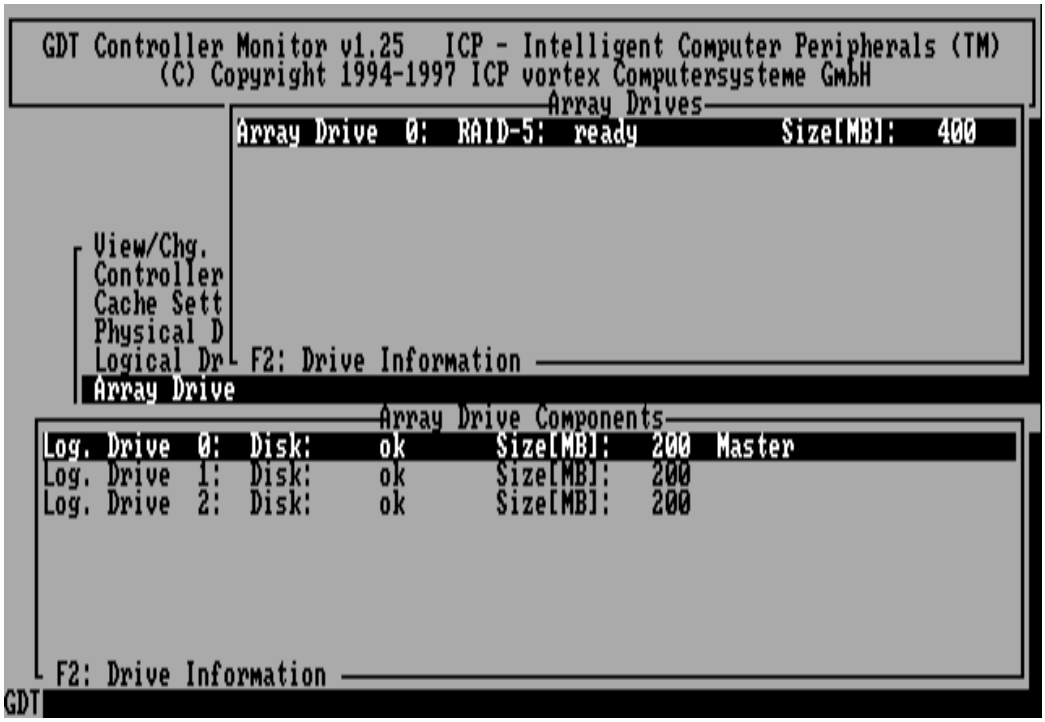
This function enables or disables the access of a certain RAID 1 or RAID 10 Array Drive to the Hot Fix Pool.

If the access had been enabled before, you could disable it now.

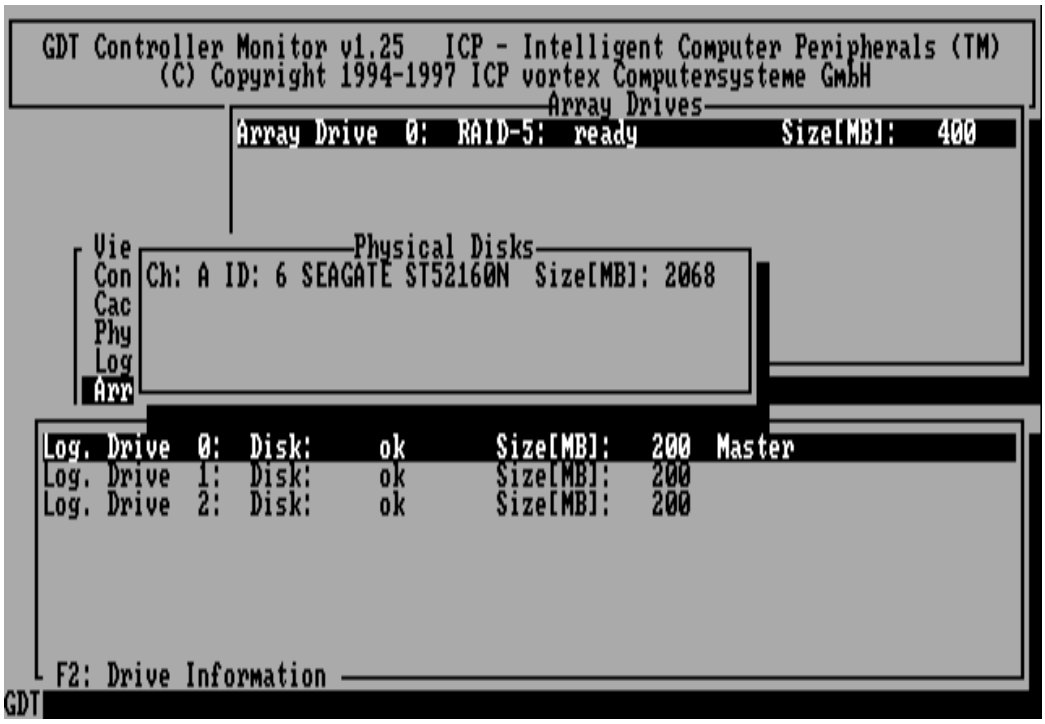
J.3.6 Array Drives

This command yields a list of the existing RAID 4 and RAID 5 Array Drives. In addition to the Array Drive number, information on the RAID level of the Array Drive: 4 or 5), the state

(error, idle, build, ready, fail, expand, rebuild) and the net capacity are displayed. Press <F2> to obtain further information on a selected Array Drive.



If you press once more <F2>, you get detailed information on the physical hard disk.



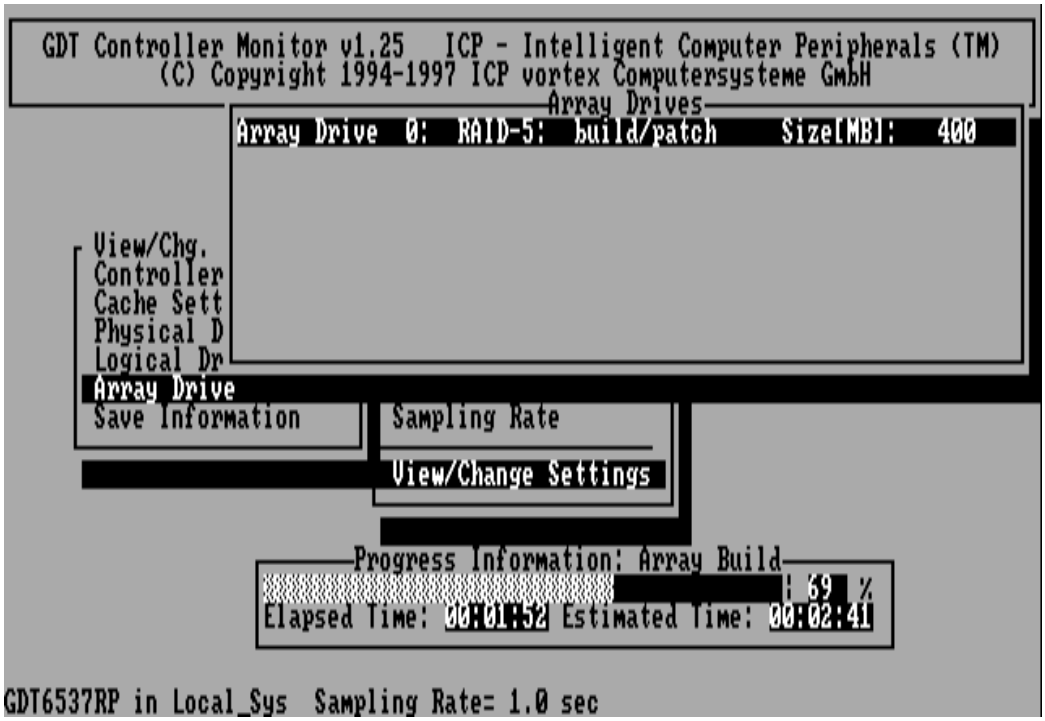
J.3.6.1 Parity Verify

This option verifies online the parity information of the selected RAID 4 or RAID 5 Array Drive. Pressing <ESC> terminates this process. If this option is selected for several Array Drives, the processes are put into a queue and performed one after the other.

J.3.6.2 Parity Recalculate

If the parity verify option reports a parity problem, it is advisable to recalculate the parity of the selected Array Drive anew.

The state of the Array Drive changes into "build/patch", and the build process is started immediately. The word "patch" indicates that the parity of this Array Drive was calculated anew. After this procedure the Array Drive assumes the *ready/patch* sate.



J.3.6.3 Expand Array Drive

There are two fundamental functions which are available within this option:

- Migrate the RAID level of the selected RAID Array Drive
  (RAID 0-> RAID 4 and vice versa, RAID 0 -> RAID 5 and vice versa)

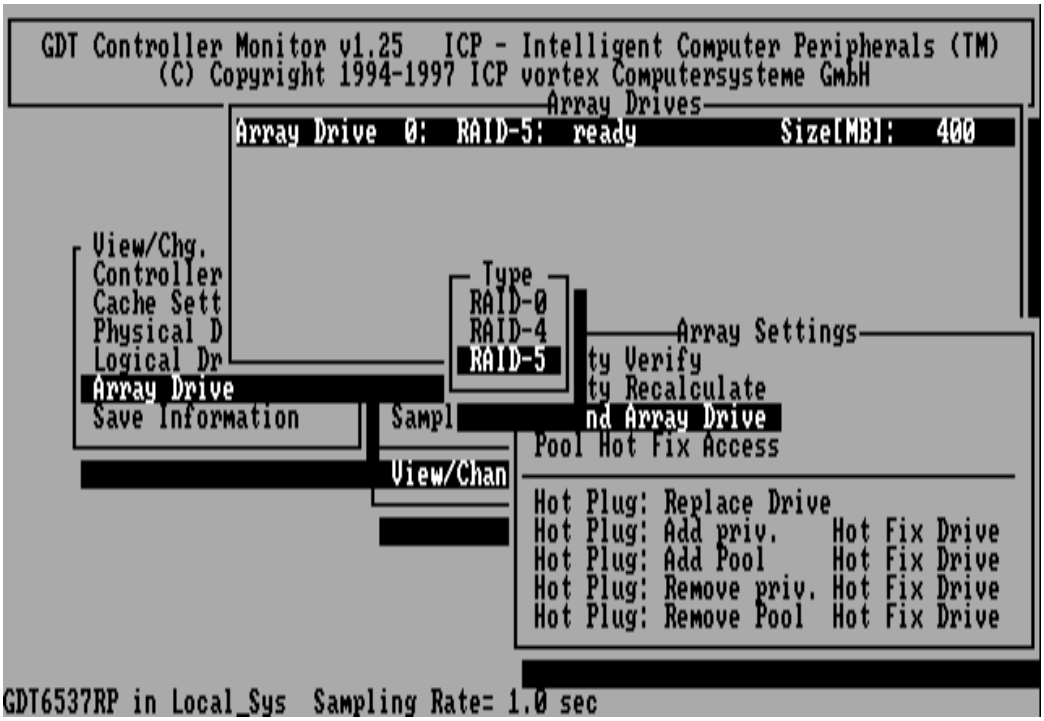
- Expand the capacity of the selected Array Drive by adding one or several new hard disks

Both functions can be selected at the same time. E.g., migrate from RAID 0 to RAID 5 and add a new drive.

To initiate a migration or expansion with a RAID 4/5 Array Drive, the state must be *ready*.
The data on the Array Drive remain intact and are not affected by the expansion.
The additional capacity is introduced as new Host Drive.
If a Logical Drive fails during the expansion, the expansion process continues until the expansion is finished. The Array Drive changes into the *fail* state.

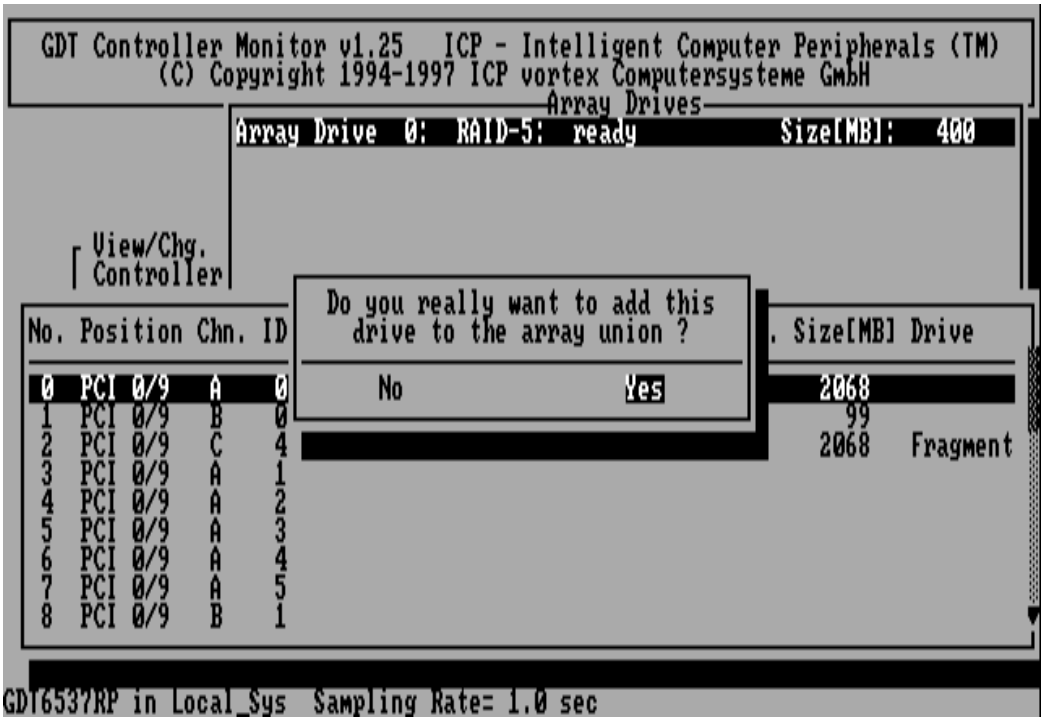
The new capacity is available as a new Host Drive. Windows NT (Tool: Disk Administrator) and Novell NetWare (*Scan for new Devices* and then Tool: Install) allow the online integration of new disk capacity.

Depending on the RAID level the current Array Drive has, selecting a different one here, will cause the Migration of the RAID level of the Array Drive. If you select the same RAID level, the following procedure will expand the capacity of the Array Drive, only.

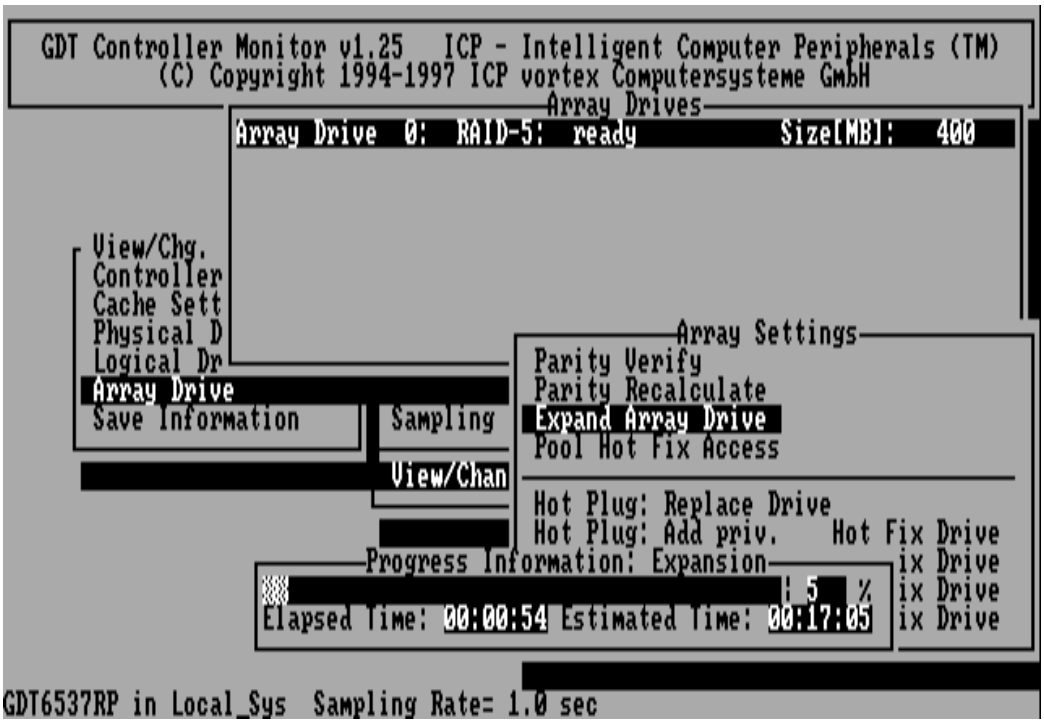


After confirming this request, the I/O channels are scanned for free positions and already existing available (i.e., not yet assigned to a Logical Drive) hard disks.

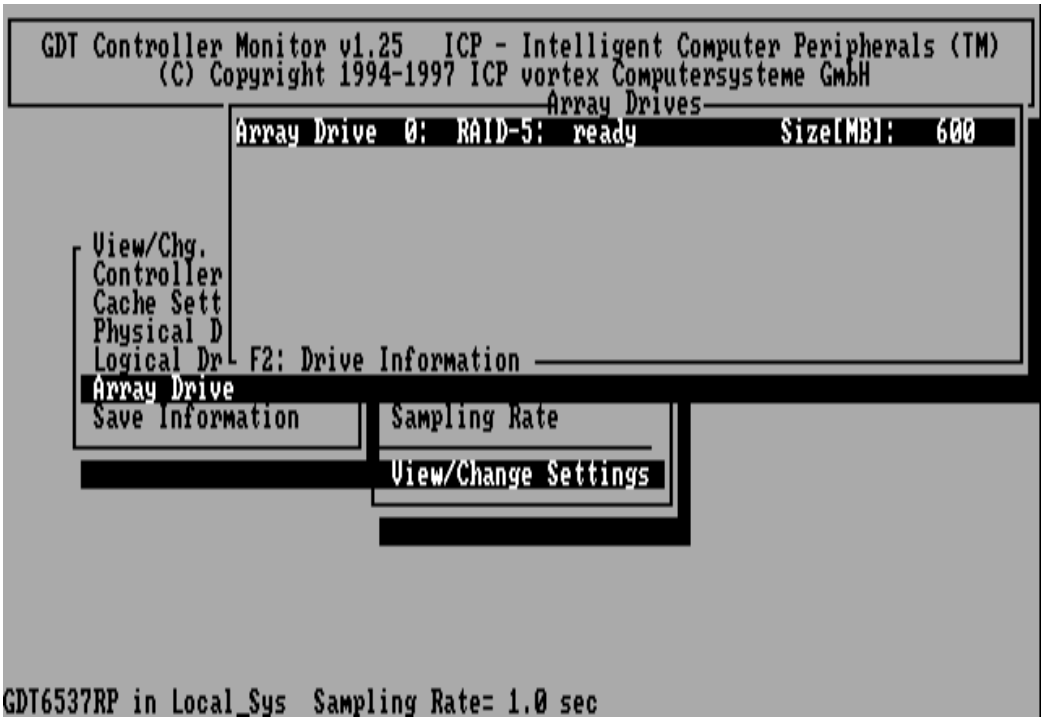
For this demo, we select the hard disk on channel A and ID 0.



The new drive is built into the Array Drive. According to the Expansion Progress Information this takes approximately 18 minutes. During the expansion the Array Drive's state is *ready/expand*.



As expected the Array Drive's capacity is now 600MB.



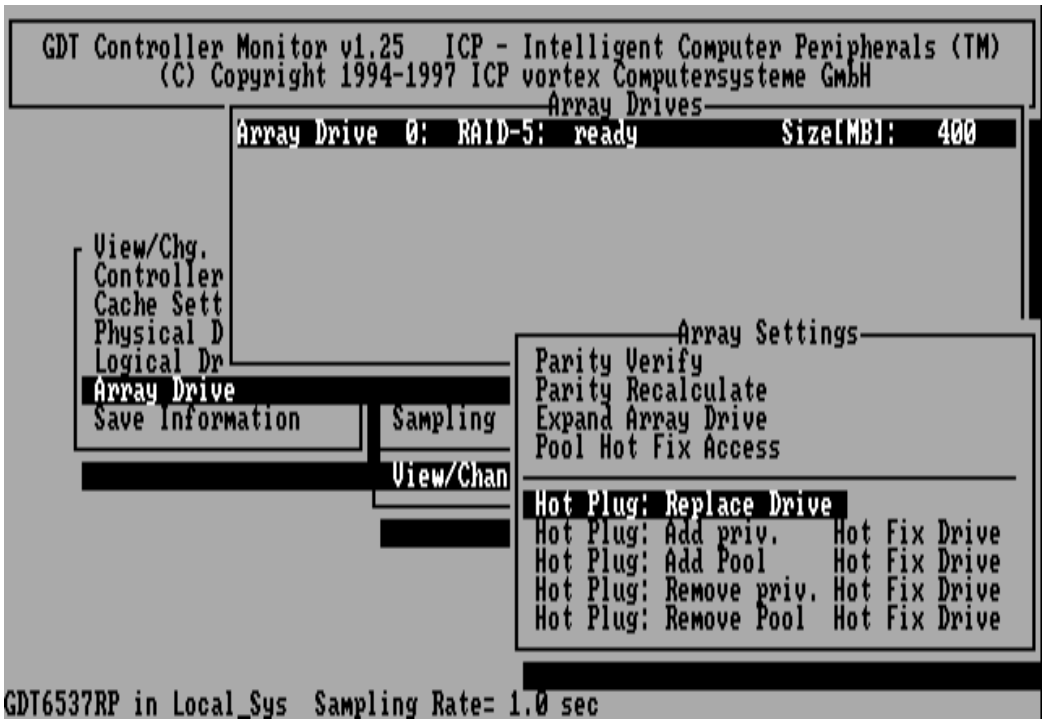
J.3.6.4 Pool Hot Fix Access

This function enables or disables the access of a certain RAID 4 or RAID 5 Array Drive to the Hot Fix Pool.

If the access had been enabled before, you would be able to disable it now.

J.3.6.5 Hot Plug: Replace Drive

In a similar way as was described a few pages before with the RAID 1 Array Drives, this function is designed to replace a defective drive of a RAID 4 or RAID 5 Array Drive, while the system continues to be fully operational.



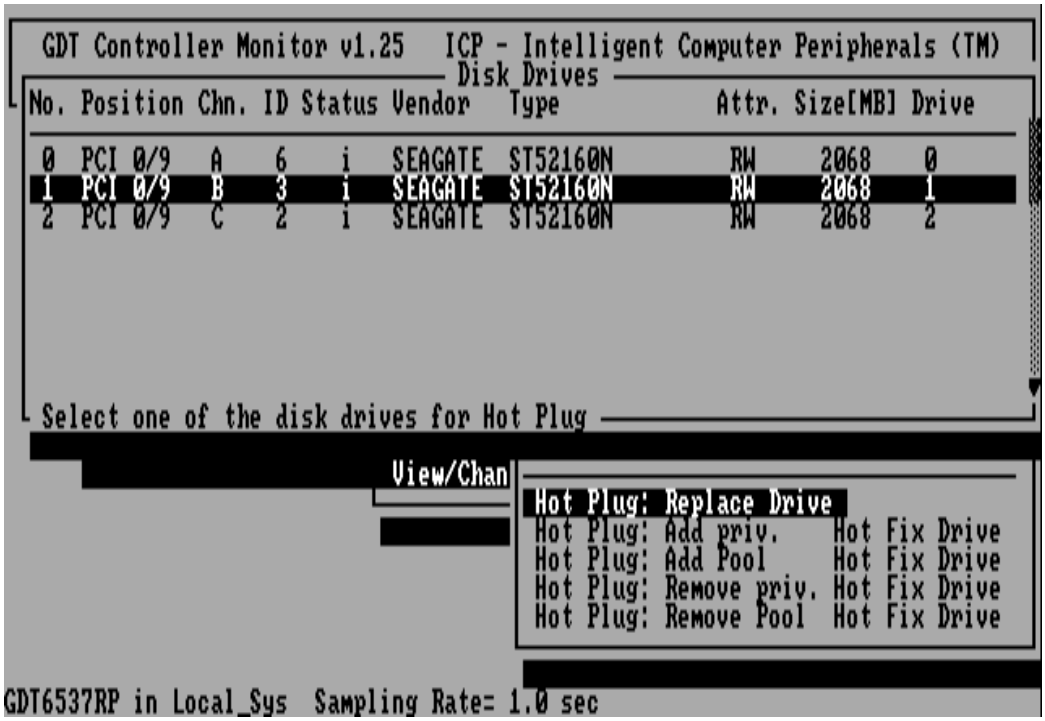
There are typically two different applications where a Hot Plug is necessary.

Application 1. The RAID 4/5 Array Drive is in the *ready* state.
It is likely that a drive will soon fail (for example when there is a loud operating noise). As a preventative measure, this drive ought to be exchanged now, that is, in a moment when the Array Drive is still in a ready state and still has redundancy.

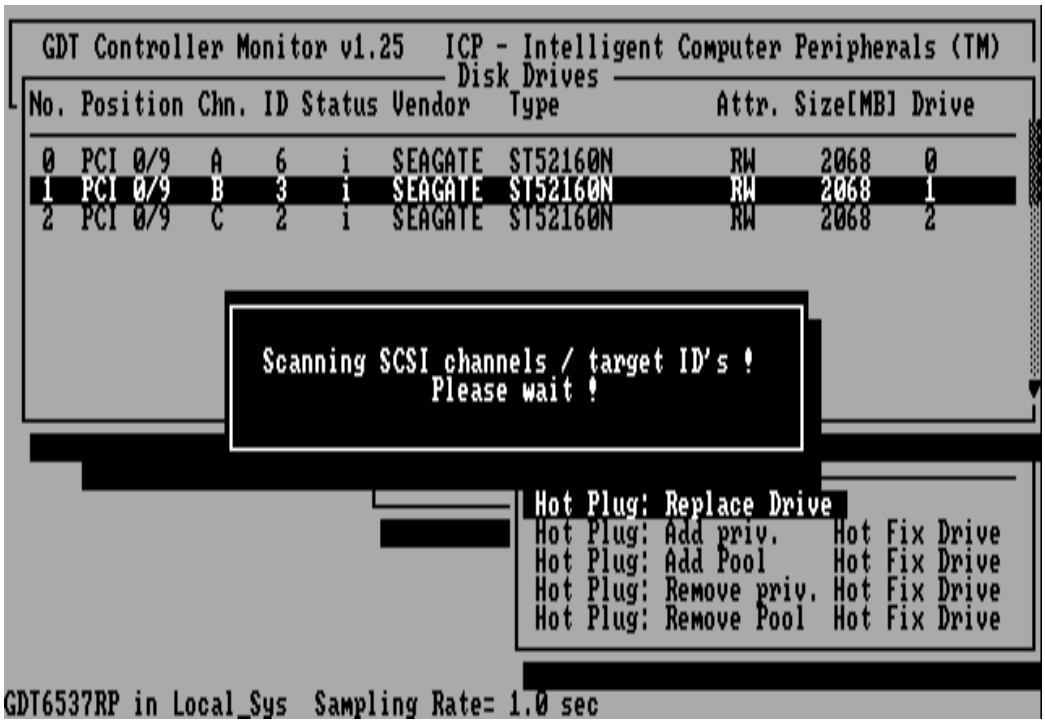
Application 2. The RAID 4/5 Array Drive is no longer fault tolerant (*fail* state), because a drive of the Array Drive has actually failed. The Array Drive is still fully operational, but it does not have redundancy any more. If another drive should also fail, the Array Drive's functionality is impaired.

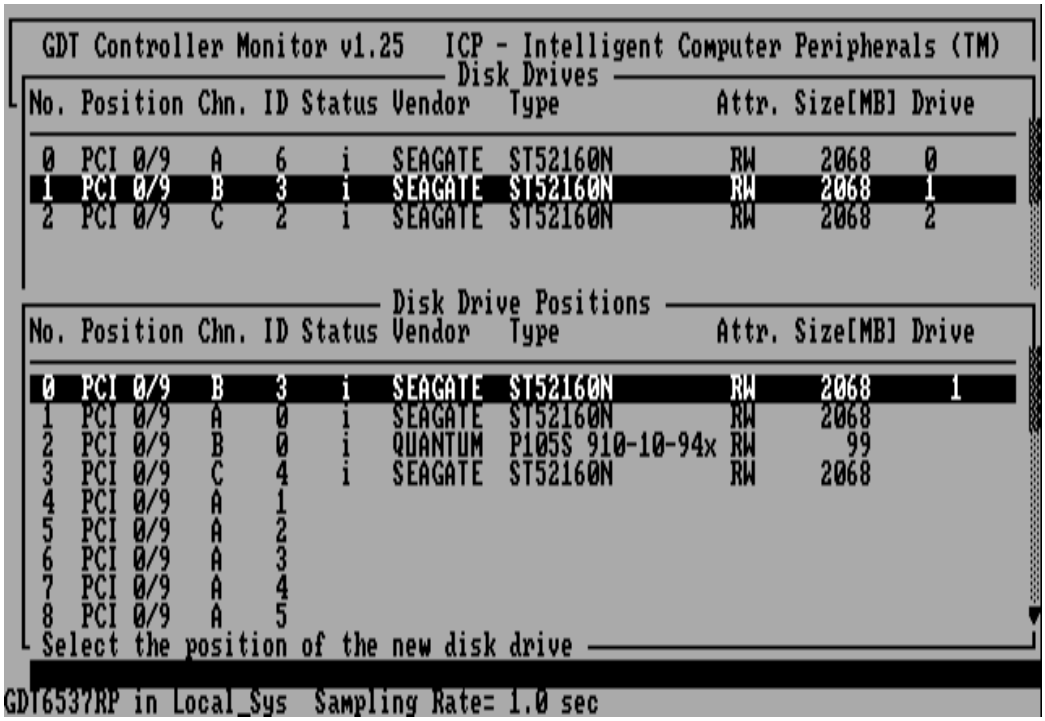
Example Session for Application 1

We assume that there is a RAID 5 Array Drive which is fault tolerant. Its state is *ready*, all drives are valid. After selecting the Array Drive, we choose the Replace Drive option.



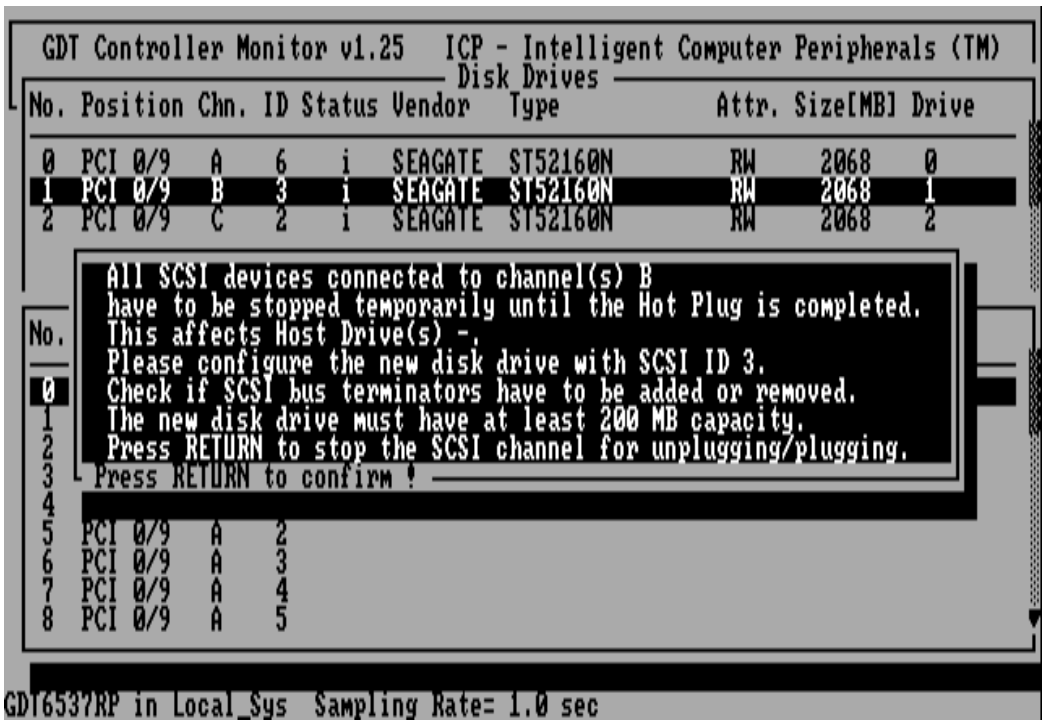
A list of the Array Drive's components is displayed. For our example we choose No.1 for the Hot Plug.
GDTMON scans the ICP Controller's I/O channels for drives which are still free (not yet assigned to Logical Drives) and free (i.e., not occupied) I/O channels and IDs.



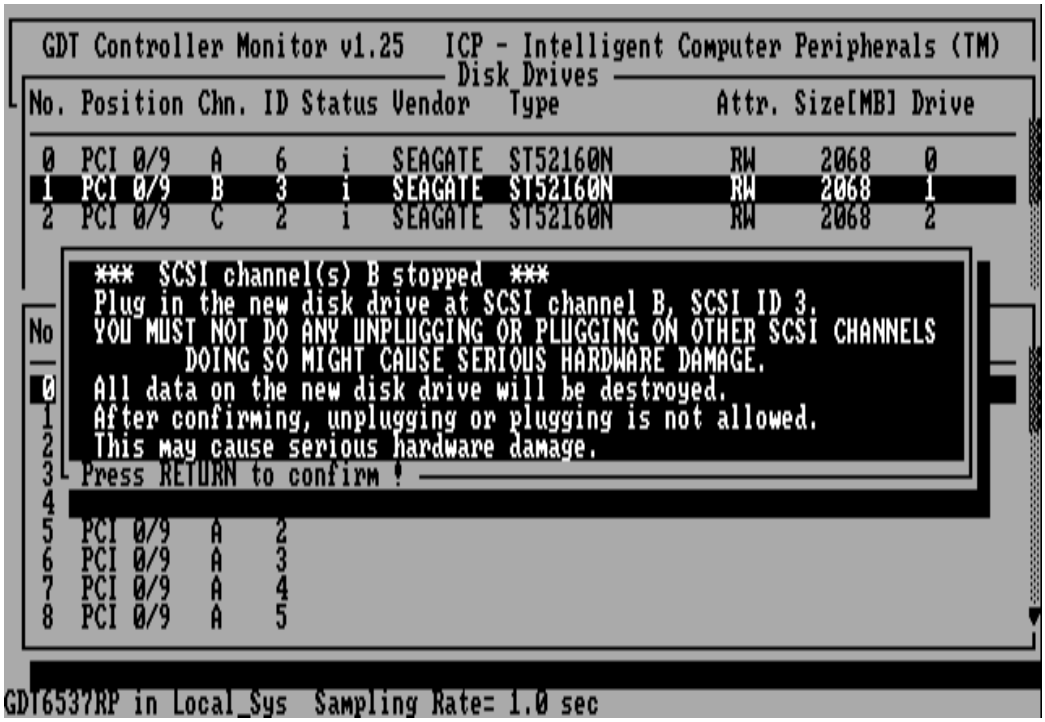


The list of Disk Drive Positions shows us the following:

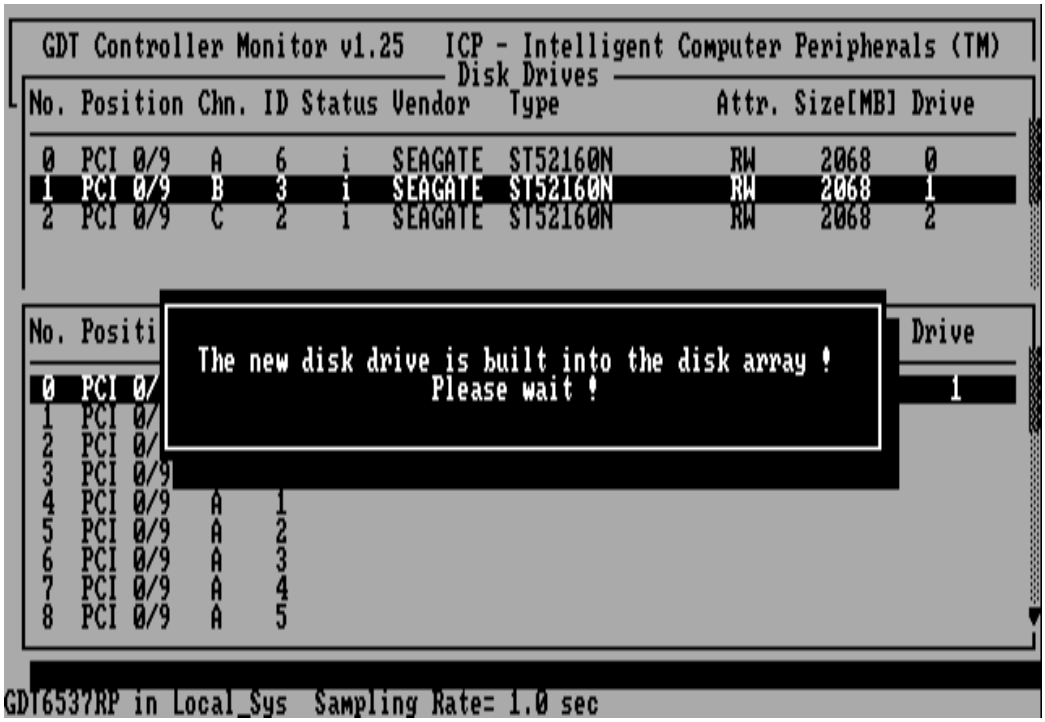
No.0	This is the position of the drive which should be replaced. Since it is still there, the hard disk's state, vendor, type, attributes, size and Logical Drive number are displayed.
No.1, 2, 3	Free available (i.e., not yet assigned to a Logical Drive) drives. 1 and 3 could also be used for the replacement.
No.4 to No.17	These are free (i.e., not occupied) plugging positions for the new hard disk (On the above screen you can't see positions No.9 to No.17, but you can scroll the list with the Page-Down/Up keys).



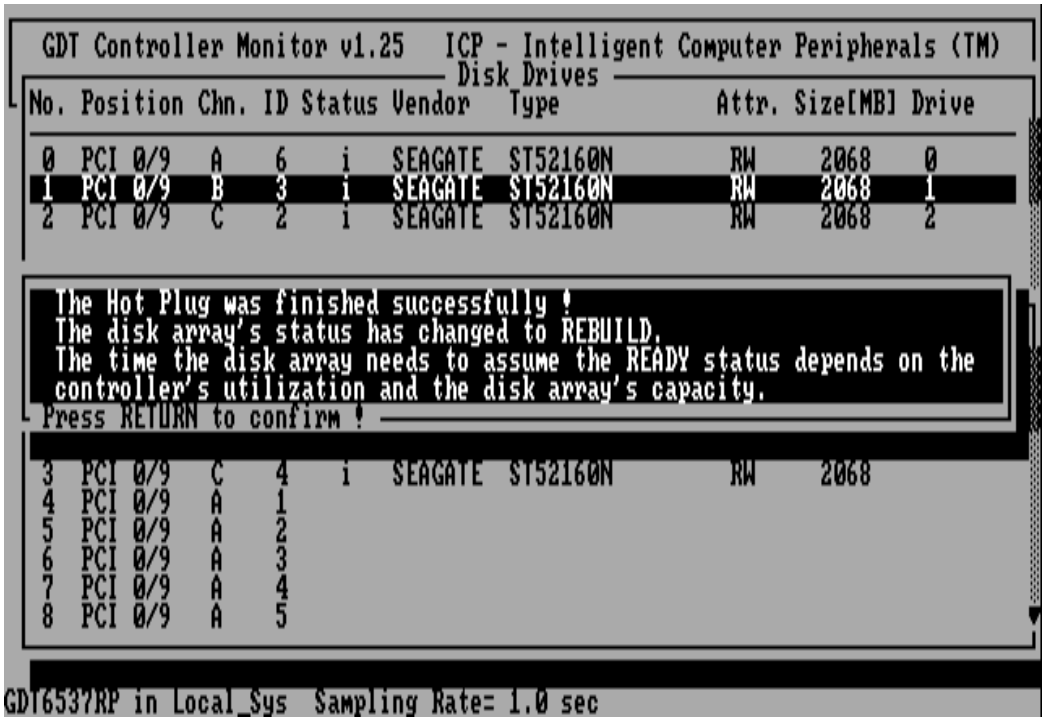
For our example we now take the new hard disk (which must have a capacity equal or larger than 200MB) set it to SCSI ID 3 and observe the SCSI termination.



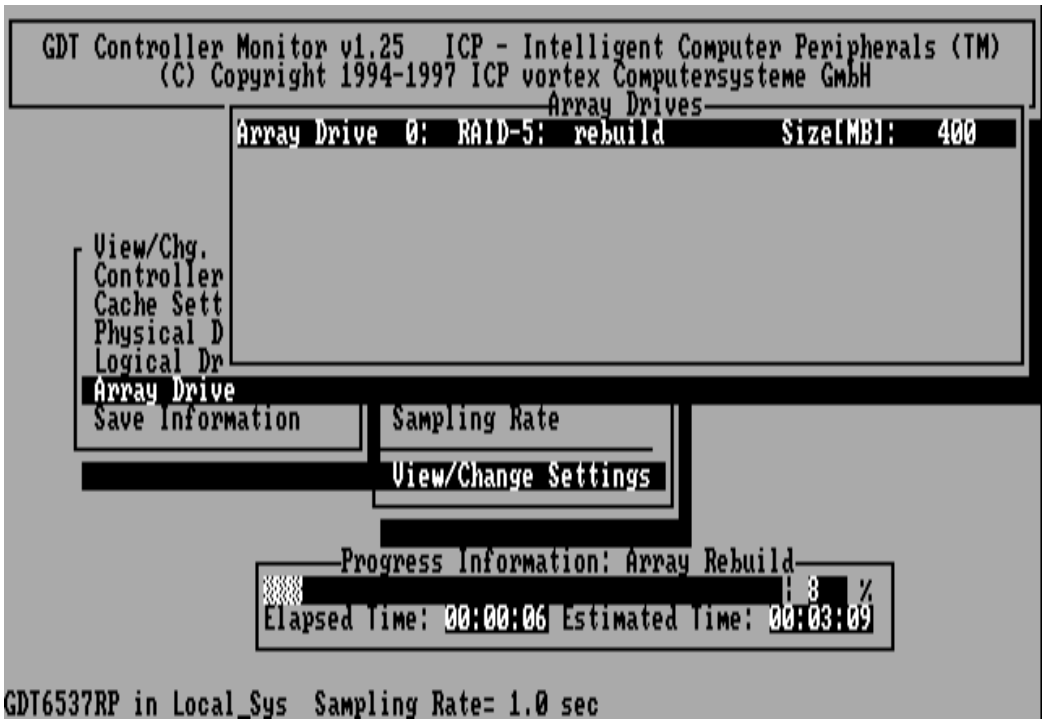
After this message we can unplug the old drive and plug in the new one again and confirm this procedure.



If everything was OK, GDTMON displays the following message:

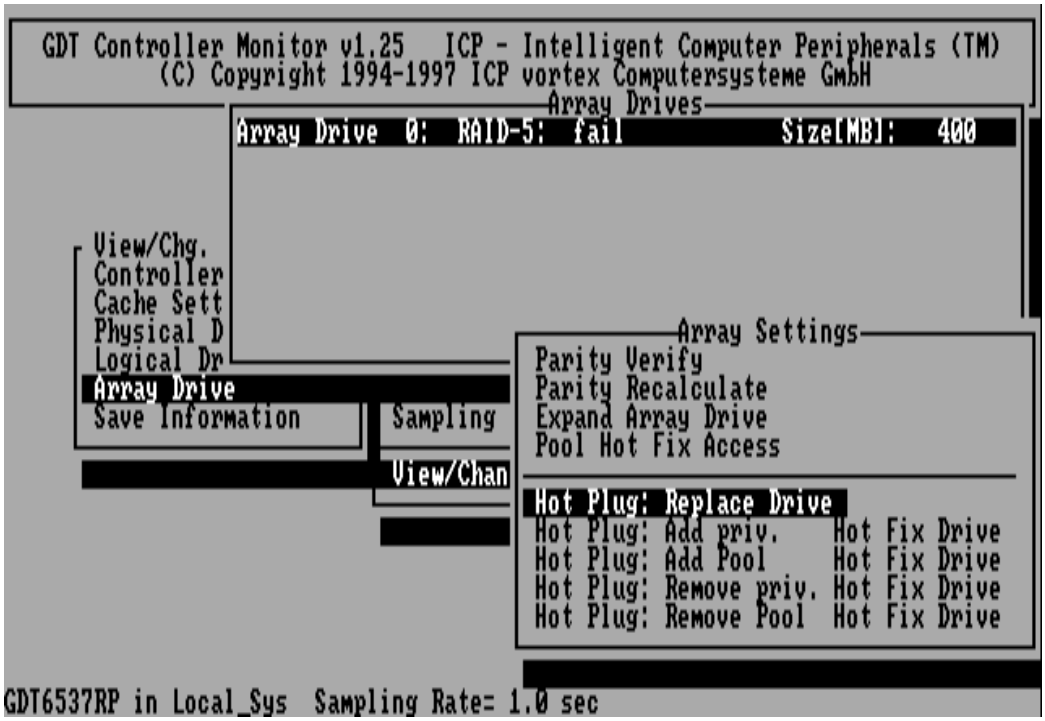


If the new drive, which we have plugged in just before, had contained data from a previous operation with an ICP Controller, GDTMON would have reported this.

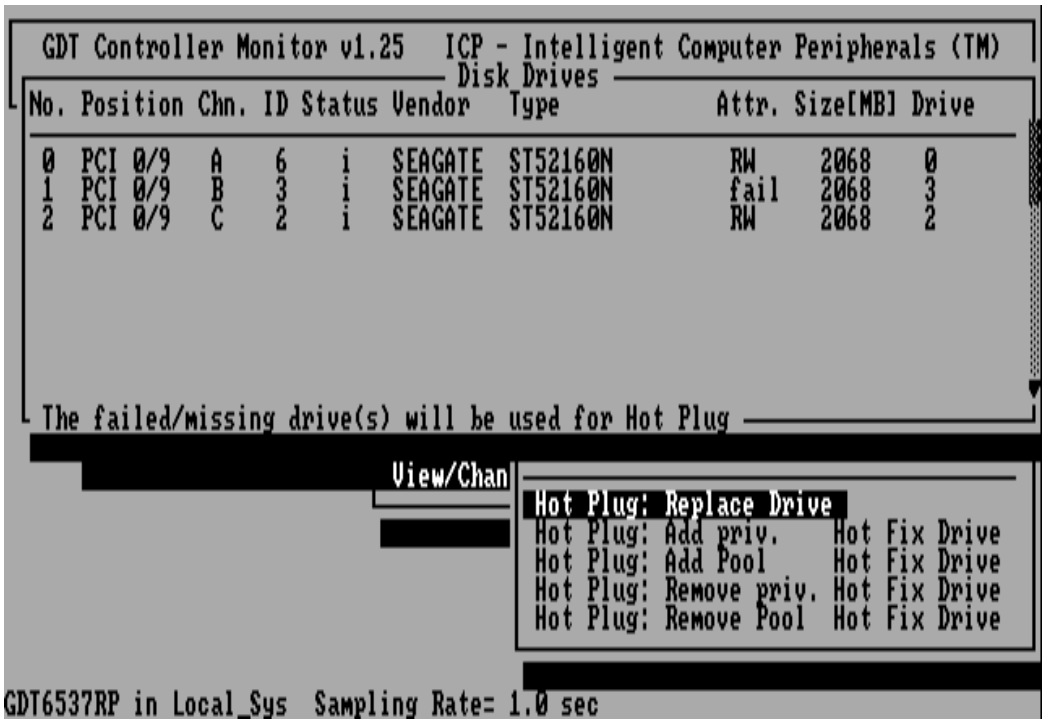


Example Session for Application 2

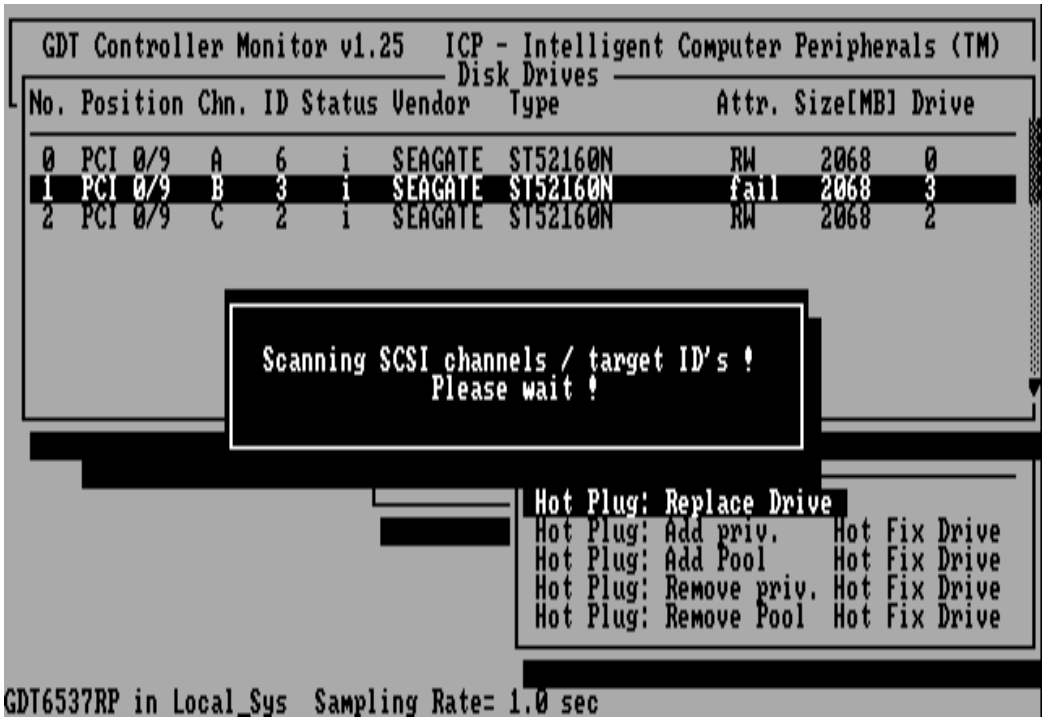
We assume that there is a RAID 5 Array Drive where one drive has failed. Its state is *fail*. After selecting the Array Drive, we choose the Replace Drive option.

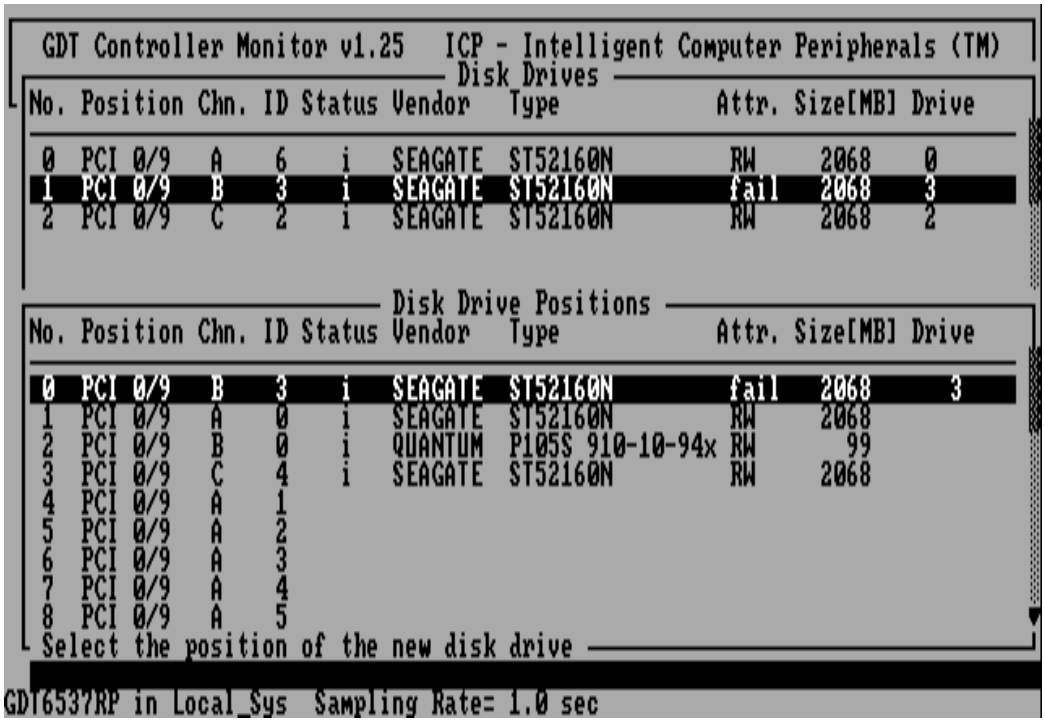


GDTMON shows the failed drive (No.1),



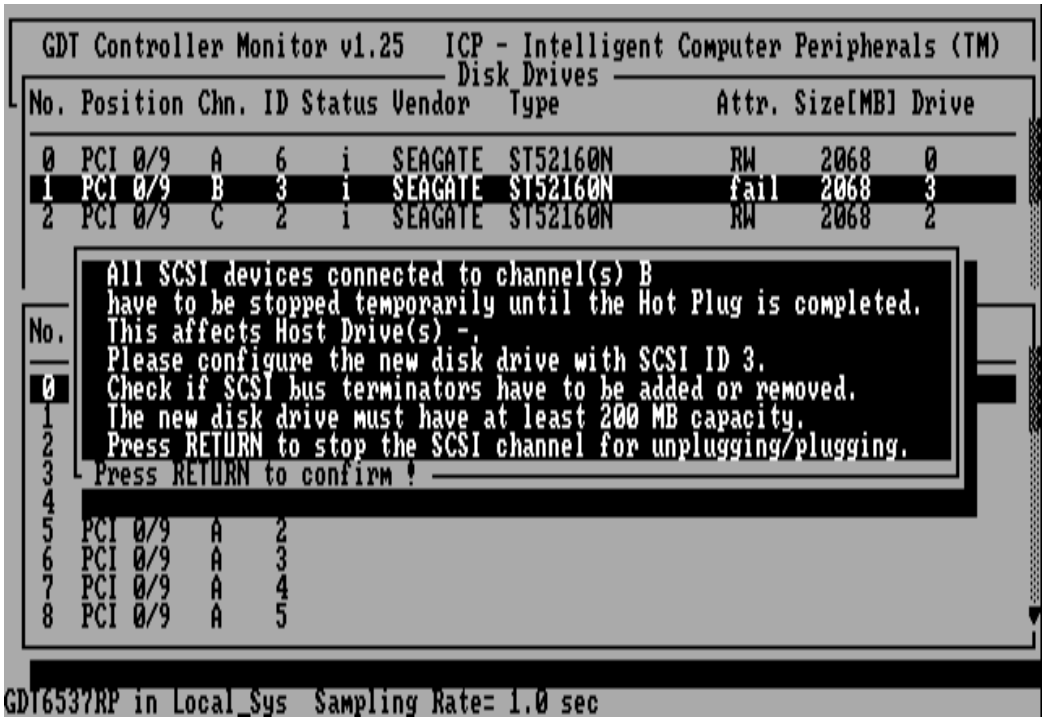
After pressing the <ENTER>-key, GDTMON scans the ICP Controller for free plugging positions:



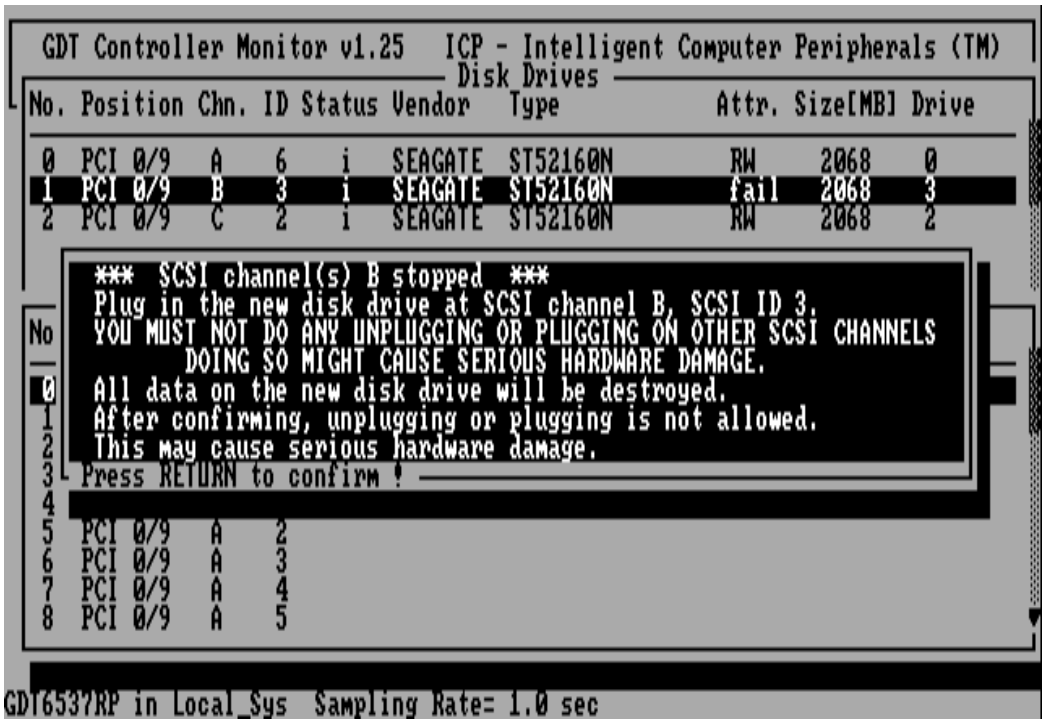


The list of Disk Drive Positions shows us the following:

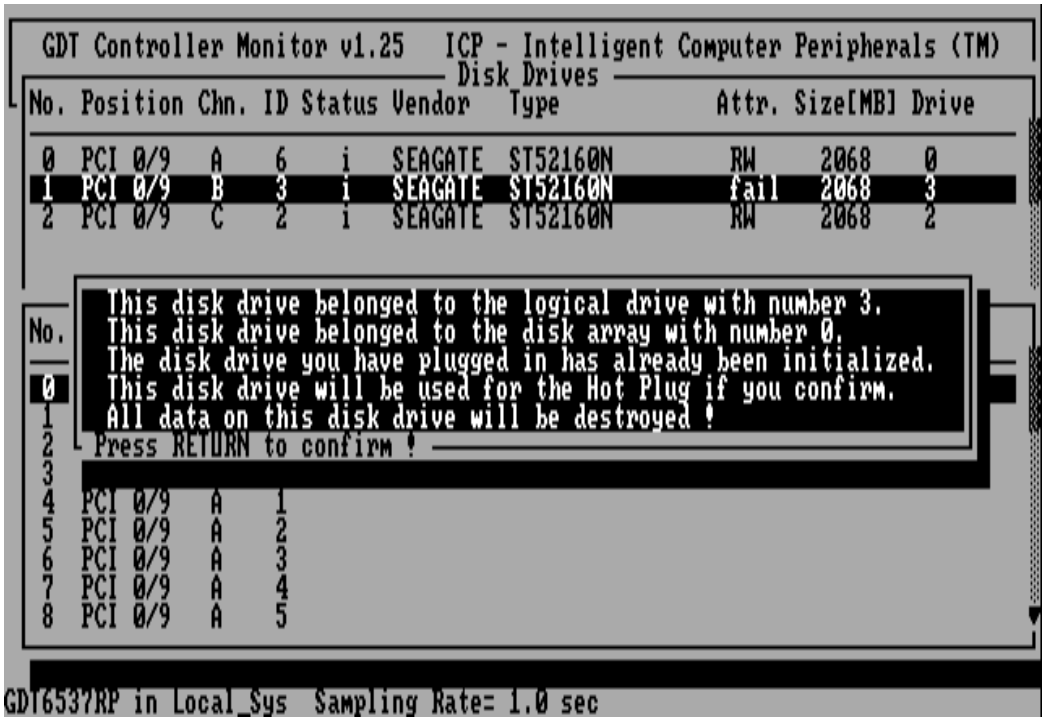
No.0	This is the position of the drive which should be replaced. Since it is still there, but defective, the hard disk's state, vendor, type, attributes, size and Logical Drive number are displayed.
No.1, 2, 3	Free available (i.e., not yet assigned to a Logical Drive) drives. 1 and 3 could also be used for the replacement.
No.4 to No.17	These are free (i.e., not occupied) plugging positions for the new hard disk (On the above screen you can't see positions No.9 to No.17, but you can scroll the list with the Page-Down/Up keys).



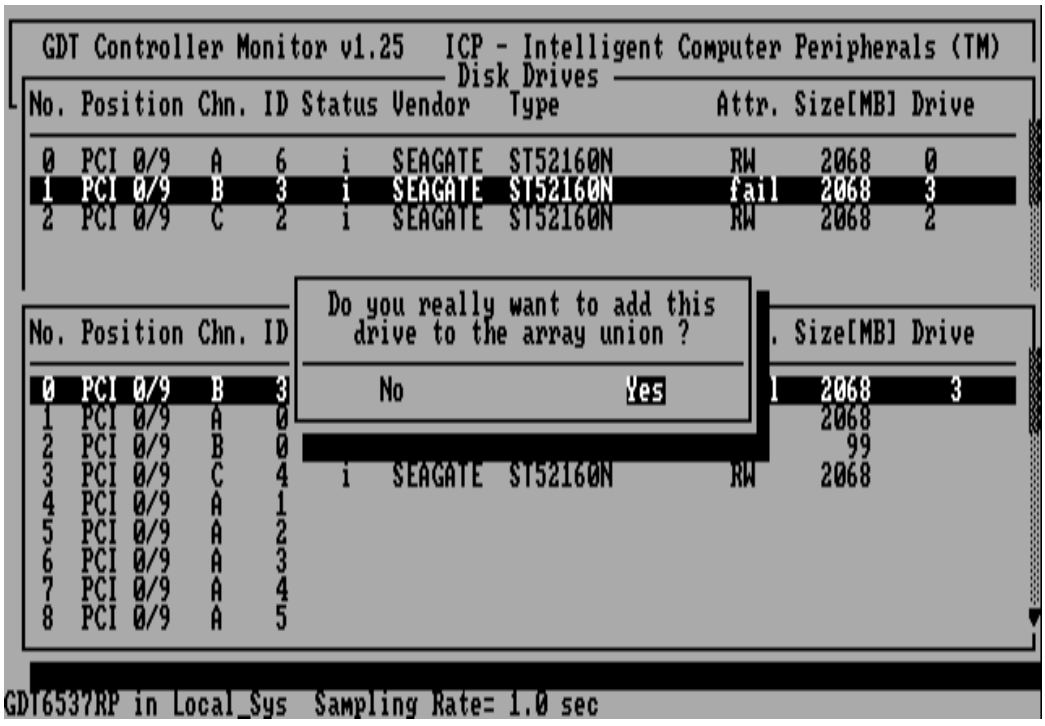
For our example we now take the new hard disk (which must have a capacity equal to or larger than 200MB) set it to SCSI ID 3 and observe the SCSI termination.



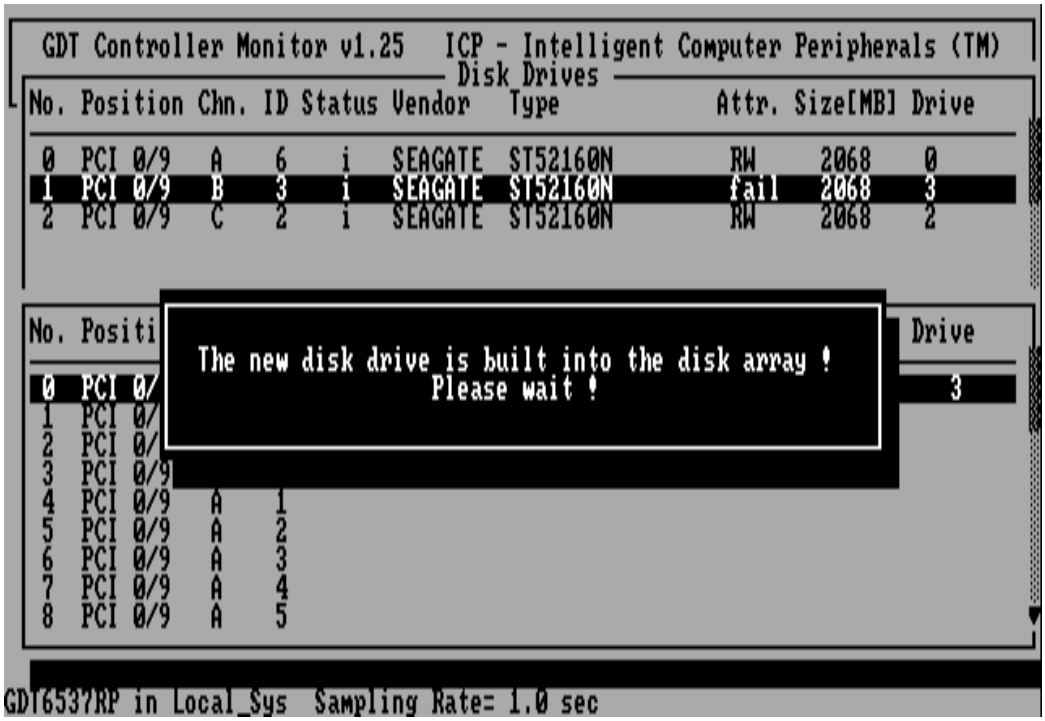
After this message we can unplug the old drive and plug the new one in again and confirm this procedure.

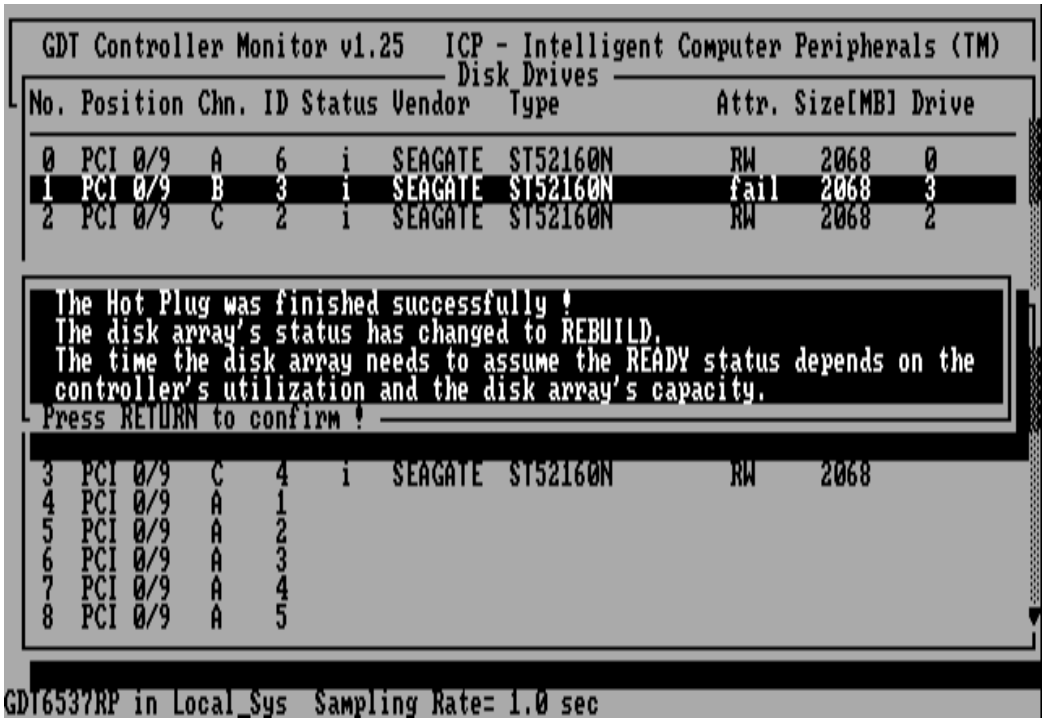


GDTMON has detected data on the new drive (i.e., it was already used as a Logical Drive with an ICP Controller).

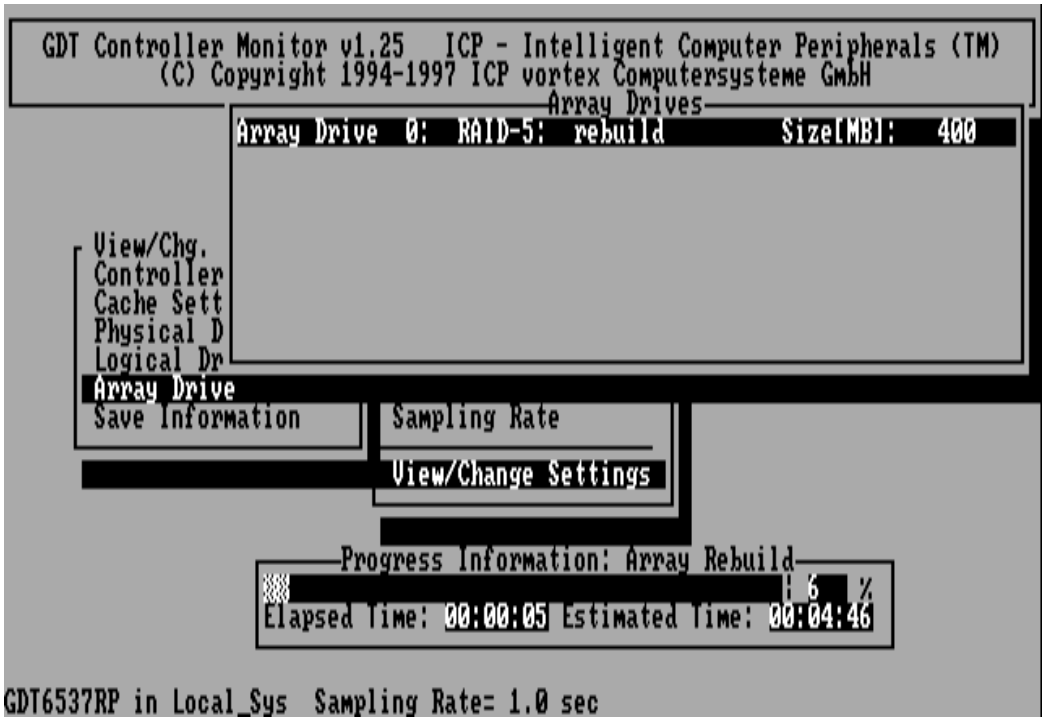


This confirmation deletes all data on the new drive and prepares it for the Array Drive.



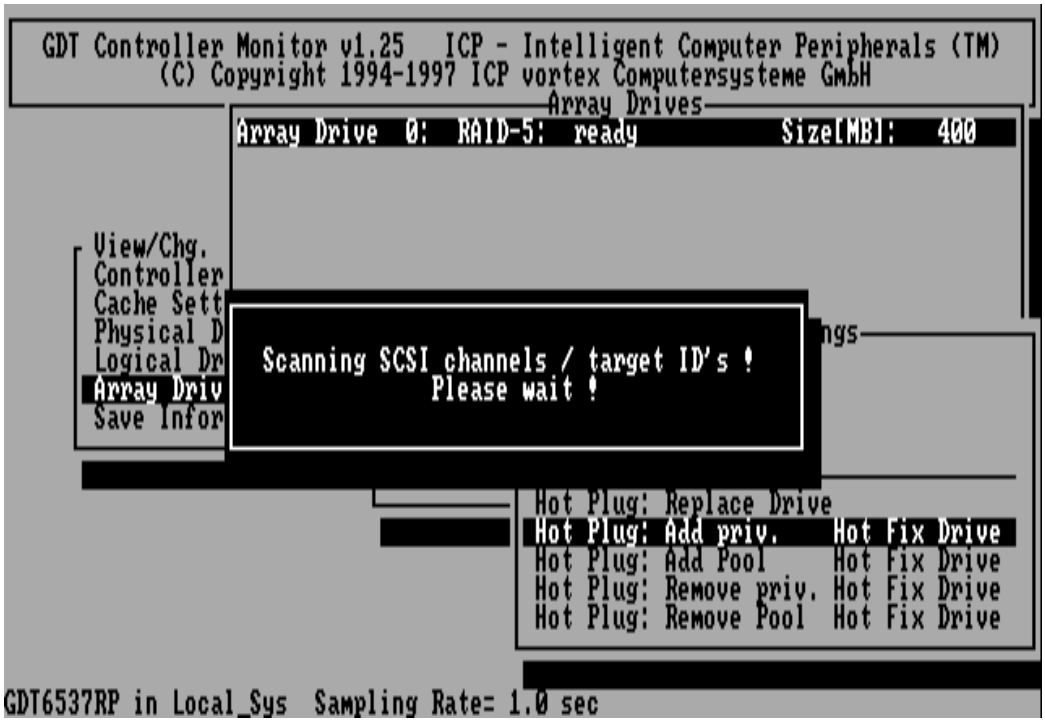


The Array Drive changes its state to *rebuild*. This means that the ICP Controller rebuilds the original data on the new drive.

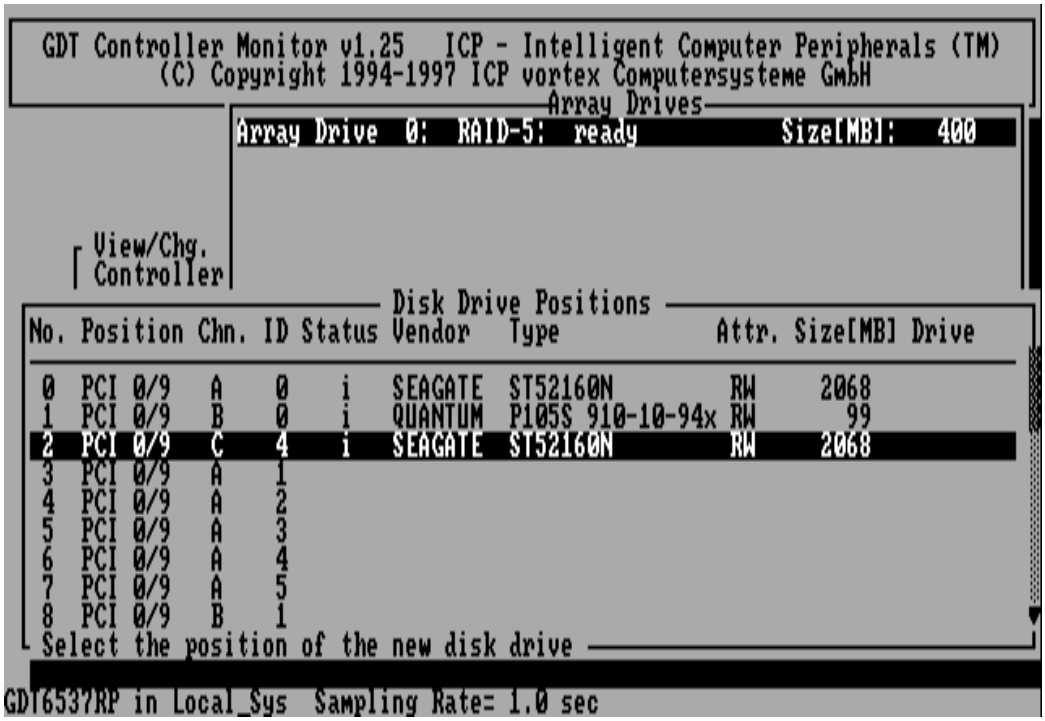


J.3.6.6 Hot Plug: Add private Hot Fix Drive

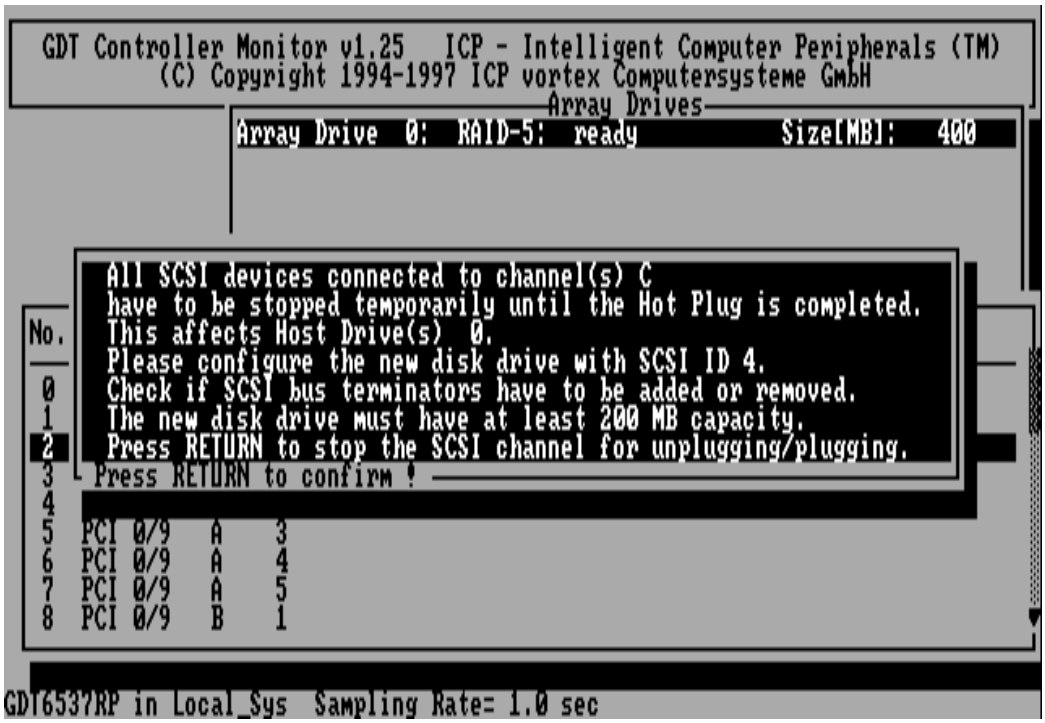
This function allows you to add a Hot Fix Drive to an existing RAID 4 / RAID 5 Array Drive. "Private" means that this Hot Fix Drive is only available for the selected Array Drive and cannot be accessed from other Array Drives.



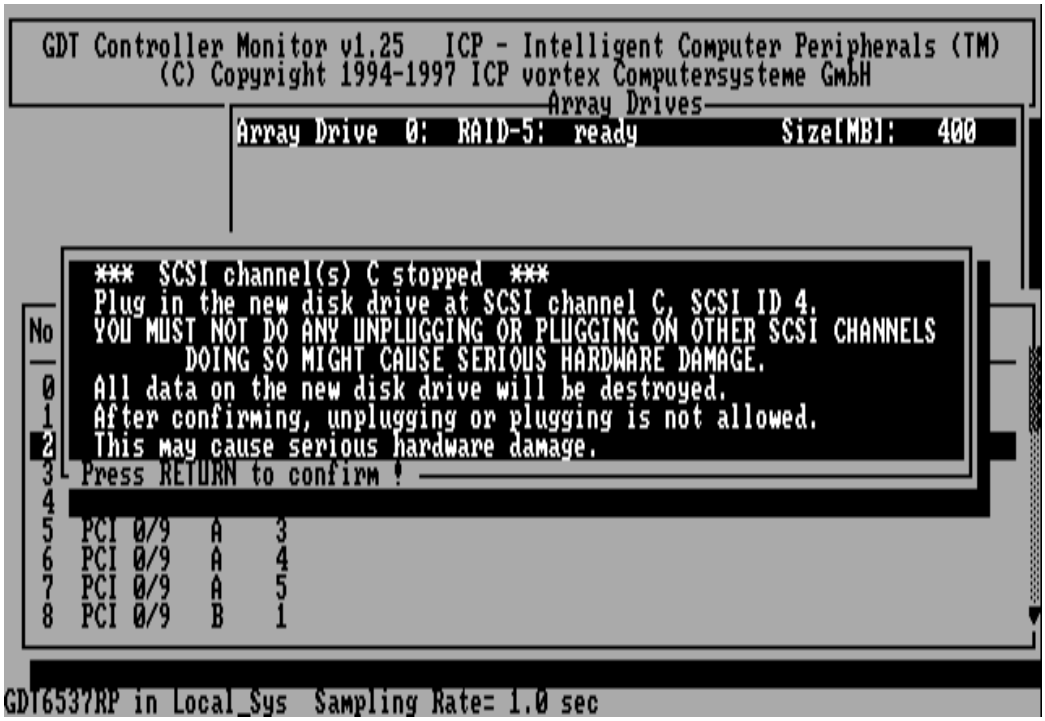
After selecting this option GDTMON scans the ICP Controller for free positions where the new Hot Fix Drive can be plugged in.



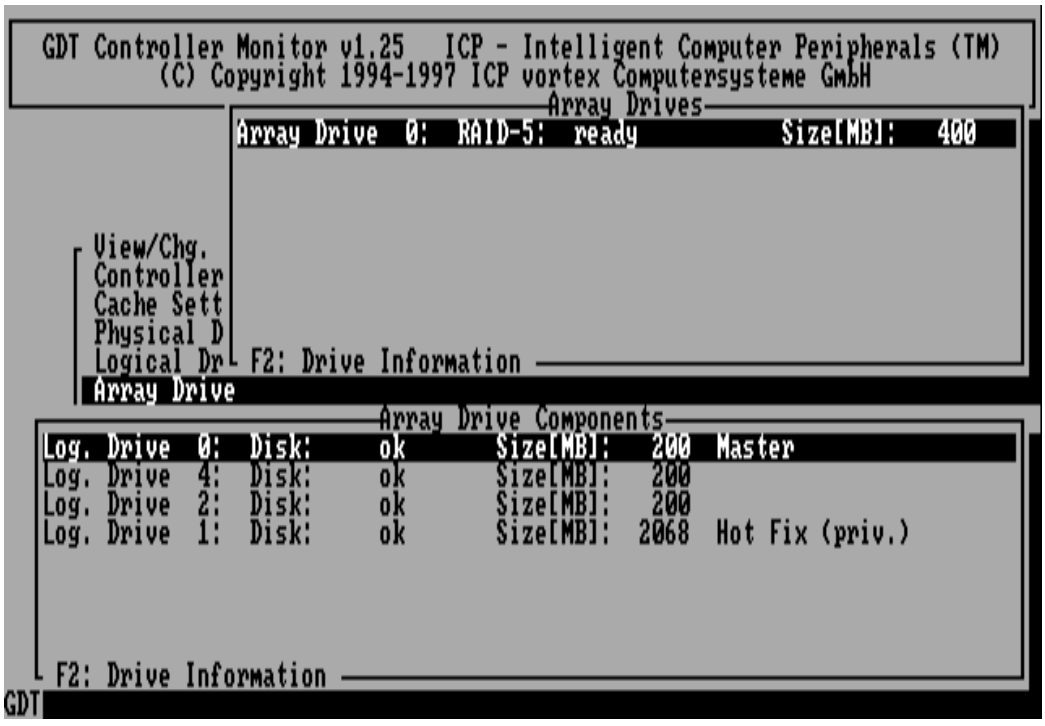
For our example, we choose the drive on Channel C and SCSI ID 4. (If we would plug in now a new drive we would have to set the SCSI ID to 4 and make sure that the SCSI termination is set properly).



GDTMON adds the new drive to the selected Array Drive.

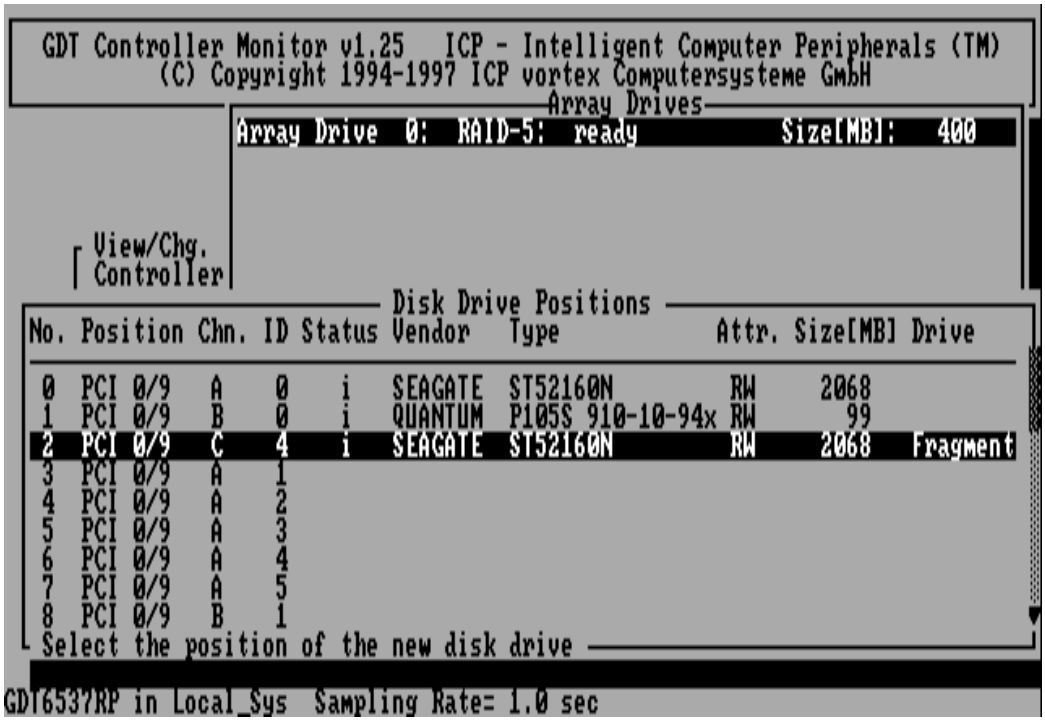


If we now look at the Array Drive's structure (press <F2>), we can see the new drive added as a Hot Fix Drive to the Array Drive.

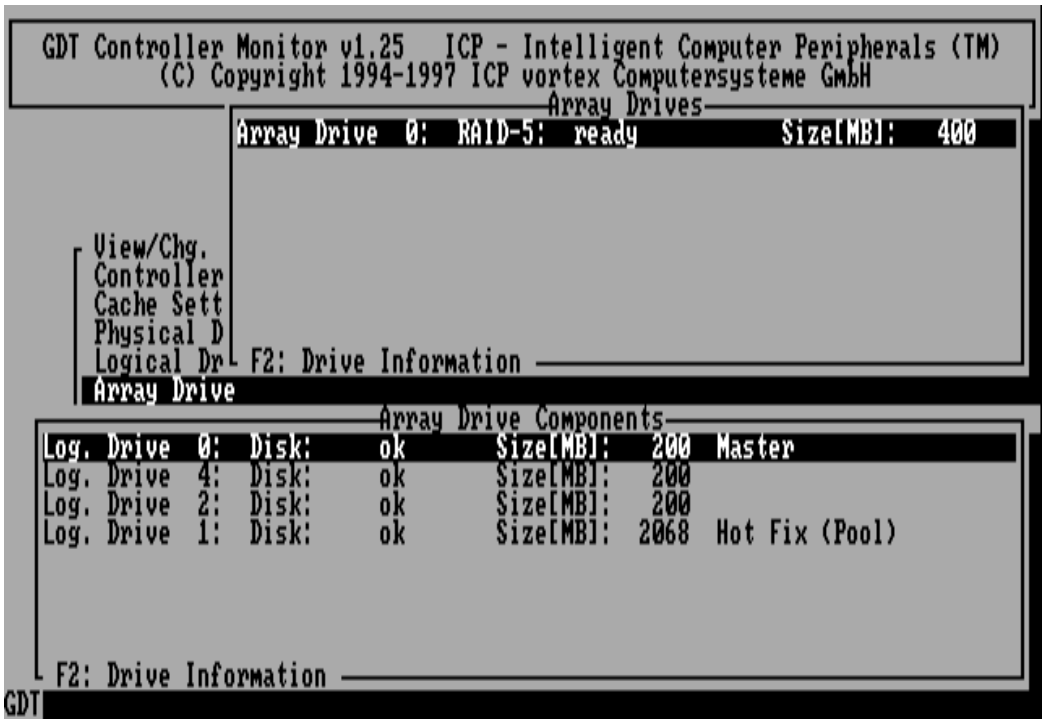


J.3.6.7 Hot Plug: Add Pool Hot Fix Drive

A Pool Hot Fix Drive is a spare drive within the so-called Hot Fix Pool. A drive in a Hot Fix Pool is available for several RAID 4/5 Array Drives as a Hot Fix drive. Thus, several Array Drives can share one Hot Fix drive. Of course, once this drive has been used by one of the Array Drives, it is no longer available for the others.



We select SCSI Channel C and ID4 for the new Pool Hot Fix Drive.



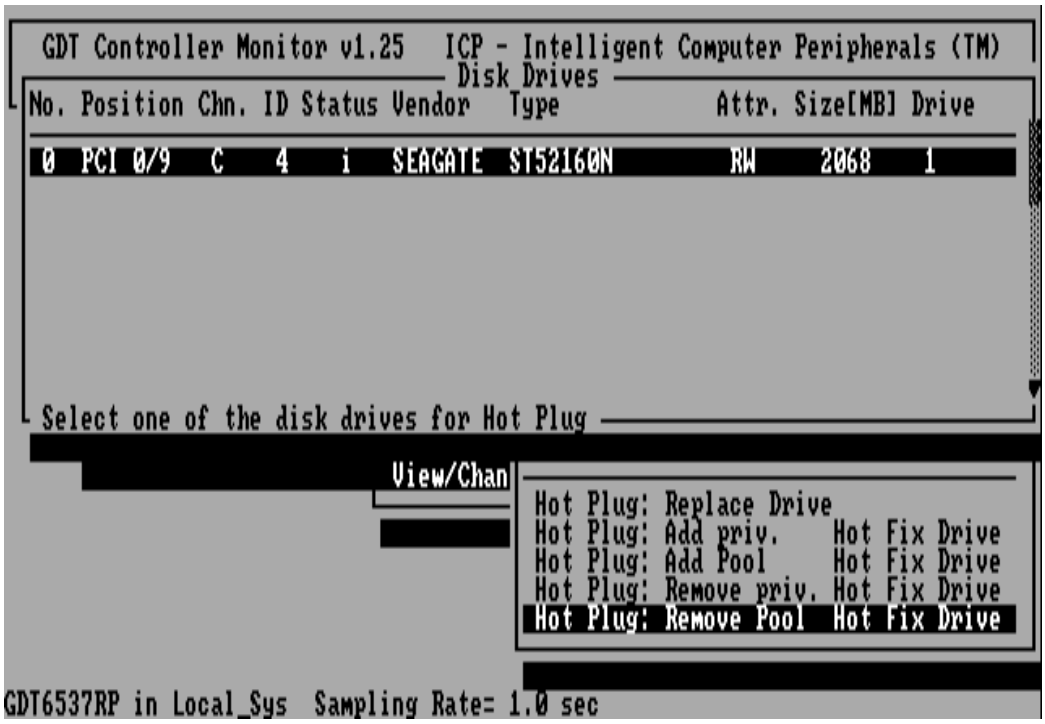
You may disable or enable the access of a certain RAID 4/5 Array Drive to the pool of Hot Fix Drives with the option "Pool Hot Fix Access" (see J.3.6.4).

J.3.6.8 Hot Plug: Remove Private Hot Fix Drive

This function is used, if you want to remove a private Hot Fix Drive from an Array Drive.

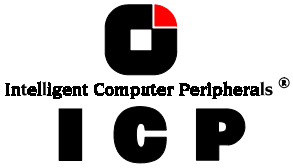
J.3.6.9 Hot Plug: Remove Pool Hot Fix Drive

In a similar way as with the "Remove private Hot Fix Drive" function, here you can remove a Hot Fix Drive from the Hot Fix Pool. A possible reason for this could be that you want to add it as a private Hot Fix Drive to an Array Drive.



J.3.7 Save Information

The *Save Information* option gives you the possibility to save the configuration information regarding the selected ICP Controller and its devices in an ASCII-file. This may help if you require support and is also good for your system documentation.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ICP

Chapter K

ICP RAID Navigator

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ICP

K. ICP RAID Navigator

K.1 Introduction

The ICP RAID Navigator (ICPRNAV) is a powerful tool for setting up, monitoring and maintaining mass storage subsystems based on ICP Controllers. Different to GDTMON, the ICP RAID Navigator is a pure GUI-style application, designed for the operation under Windows 95, 98 and NT. The main features are:

Setup of hard disks controlled by the ICP Controller

- Setup and initialize Physical Drives, change the SCSI parameters and cache settings.
- Easy setup and installation of single disks or Array Drives consisting of one or more Physical Drives (chaining, RAID 0, 1, 4, 5 or 10).
- Online installation of Host Drives based on a single disk or an Array Drive.

Maintenance and tuning of existing Array Drives, Host Drives and the ICP Controller

- Configure the cache memory.
- Update the controller firmware.
- Change the device parameters.
- Check or recalculate the parity data of RAID 4 and RAID 5 Array Drives.
- Online capacity expansion of Array Drives.
- Split and merge Host Drives.
- Hot Plug. Replace a failed member of an Array Drive.
- Hot Fix. Configure a spare disk for an Array Drive.
- Configure SAF-TE compliant enclosures.

Monitoring of the whole subsystem

- Watch the performance and throughput of virtually every part of the subsystem. Simply drag-and-drop the device on the statistics window.
- Check the hard disks for retries and reassigns (replacements of defective sectors on a hard disk) to trace problems which might become potential in the future.
- Check the grown defect table of the hard disks to replace a defective drive in time.

Remote configuration and maintenance

- Except the Hot Plug function, all of the above features can be accessed via network. You can maintain and monitor a customer‘s server via the Internet.
- Supported protocols: IPX/SPX
TCP/IP
NetBIOS
- The access to the ICP Controller can be protected by password. The password is encrypted.

To install the ICP RAID Navigator, use the "Setup" program on the ICP System CDROM.

K.2 The ICP RAID Navigator "Controls"

K.2.1 The Toolbar

The toolbar can be made visible or hidden by selecting "Toolbar" from the "View" menu:
By clicking on the different buttons you can open and close the windows of the corresponding programs of the ICP RAID Navigator:

The toolbar can be moved away from the top of the RAID Navigator window and is then shown in a small extra window. To place the toolbar back under the menu bar you can double click on the top window bar of the toolbar or drag & drop the toolbar back under the menu bar. You can also place the toolbar on the bottom of the RAID Navigator window.

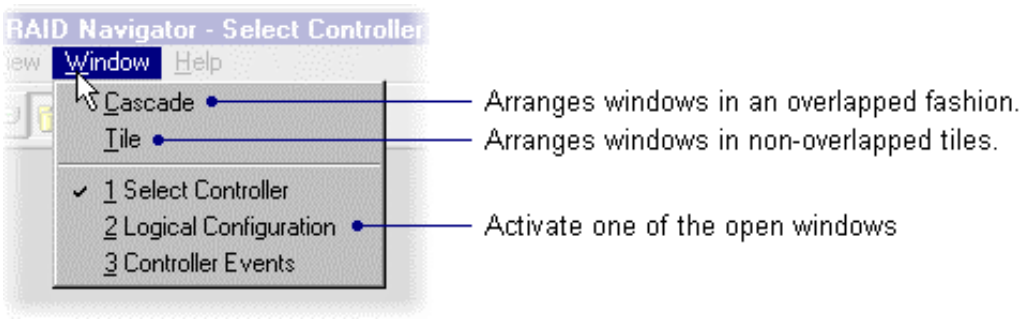
Icon	Opens / closes	Description
	Select Controller	Select a local or remote ICP Controller for further actions.
	Physical Configuration	Show and/or modify the ICP Controller and device settings.
	Logical Configuration	Show and/or modify the Logical Drive configuration.
	Statistics	Show statistics.
	Events	Show the ICP Controller events.
		Show information on the ICP RAID Navigator.
		Click on this icon and then on the icon you want online help.

K.2.2 The Status Bar

The status bar at the bottom of the main window displays status information on the icon or the menu option the mouse pointer is currently placed on. The status bar can be displayed or hidden by selecting Status Bar from the View menu.

K.2.3 "Window" Menu Commands

These commands allow you to arrange the windows in the ICP RAID Navigator application window or to activate an open window.

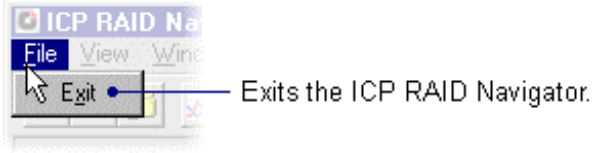


K.2.4 "Help" Menu Commands

The Help menu offers the following commands to provide you with online help:

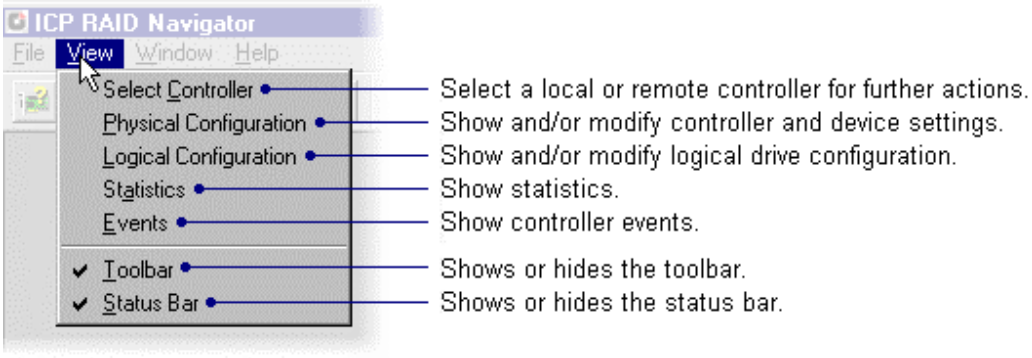
K.2.5 "File" Menu Commands

Here you can end your ICP RAID Navigator session. Shortcuts: Press Alt+F4 or click to close the window.



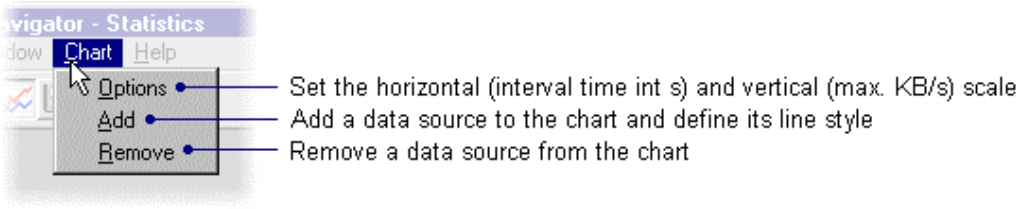
K.2.6 "View" Menu Commands

Use the items in this menu to open or close the windows of the main components of the ICP RAID Navigator or change the appearance of the main window.



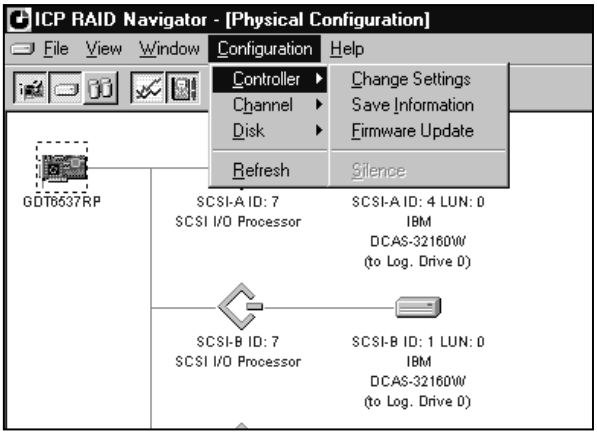
K.2.7 The "Chart" Menu

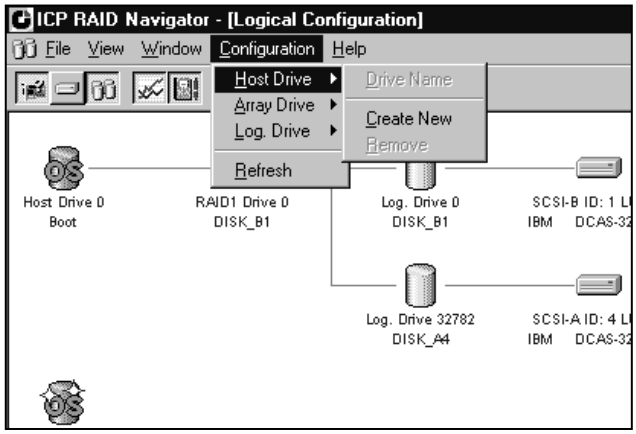
The chart menu appears when you open the statistics window. Here you can add and remove data sources from the chart and configure the chart.



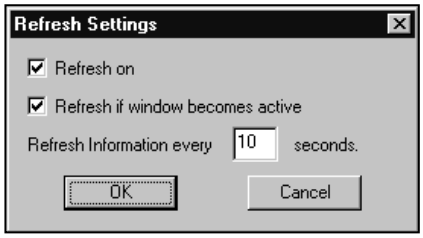
K.2.8 The "Configuration" Menu Commands

This menu appears if you have selected the Physical Configuration window or the Logical Configuration window.





Here you can set the refresh rate for the Physical or the Logical Configuration windows.
This is the rate, which is used by the ICP RAID Navigator to update the contents of the physical and logical configuration windows.

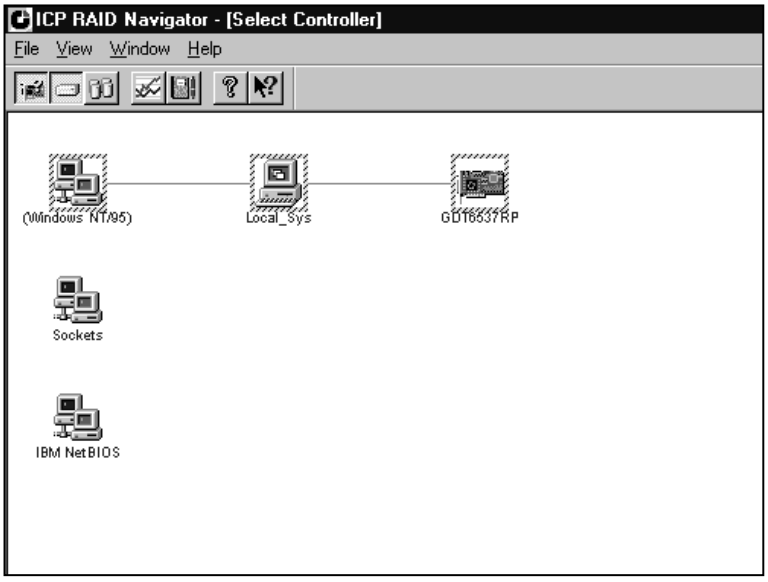


The options are:

Refresh on	Activates and deactivates the window update.
Refresh if window becomes active	Update the window if it becomes active.
Refresh information every ... seconds	Sets the frequency for automatic window refreshes.

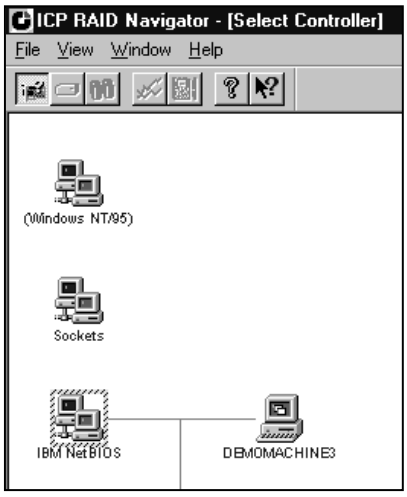
The menu options you can select here are also available if you click the right mouse button on the corresponding icon in the Physical or the Logical Configuration windows.

K.3 Select Controller

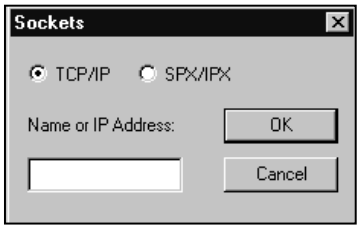


This window is used to select an ICP Controller for all further actions within the ICP RAID Navigator.

In a first step you should select the desired protocol (Windows NT/95/98, Sockets, IBM NetBIOS) for the communication between the ICP RAID Navigator and the system which is equipped with the ICP Controller by double clicking on the protocol icon on the very left side of the window. If you want so select an ICP Controller via TCP/IP (sockets), type in the corresponding TCP/IP address or the server system's name. You are then asked to enter a user name and a password. This information is transmitted with encryption.



After the protocol was selected, select the system which contains the ICP Controller and afterwards the ICP Controller itself. The selection and deselection is done by double clicking on the ICP Controller. The selected protocol, system and ICP Controller are shown in a dashed yellow frame.



No more action can be done in this menu.

K.4 Physical Configuration Window

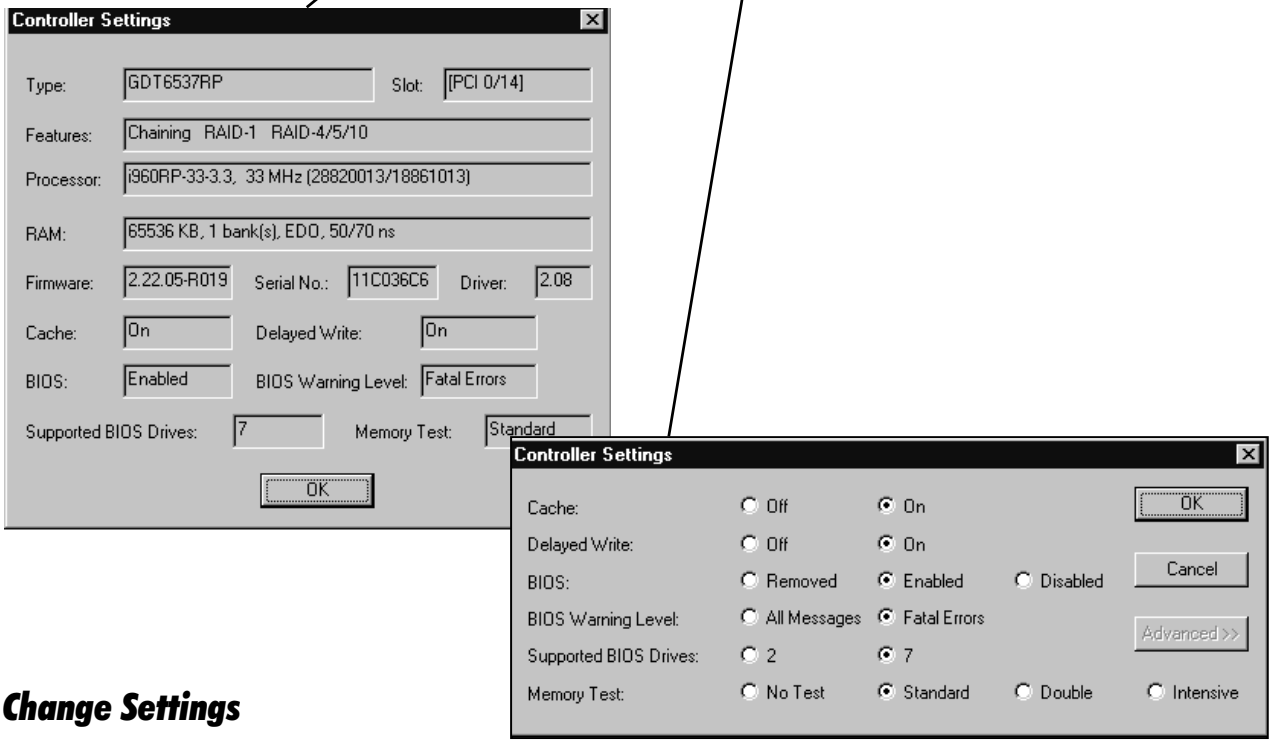
This window shows the physical configuration of the SCSI or Fibre Channel busses of the selected ICP Controller and the devices connected with these busses. The complete configuration is shown as a tree starting from the left with the ICP Controller.

To get detailed information on the single devices, double click on the icons.
The windows that open, depend on the type of the selected device.

To change the physical configuration of the devices, click the right mouse button on the desired device or select the corresponding item from the Configuration menu.
Possible choices are (Click on the popup menu items to get information on them):

K.4.1 Controllers

Icon	Description	double click opens...	right click opens...
	Controller	Controller Information	Change Settings Save Information Firmware Update Silence



Change Settings

Here you can change the settings of the ICP Controller.

Cache	Enables or Disables the ICP Controller cache. For optimum performance the cache should be always On.
Delayed Write	Enables or disables the write cache function of the ICP Controller cache. For optimum performance the write cache should be always On.
BIOS	The BIOS of the ICP Controller is needed to boot the computer and the operating system from a Host Drive.
BIOS Warning Level	Enables or disables the display of non-critical boot messages of the ICP Controller during the system boot phase.
Supported BIOS Drives	Adjust the number of Host Drives which are supported by the ICP Controller's BIOS. This is the number (2 or 7) of Host Drives which are available under DOS without loading a special driver.
Memory Test	Configures the strategy and duration of the ICP Controller cache memory test during the boot phase. A more intensive test requires more time.

Save Information

After the selection of this option a file dialog is opened, which allows you to specify the path and name of the Save Information file. This file has a standard ASCII format and can be viewed or printed with a normal editor (e.g., notepad) or word processing system.

The Save Information file contains all relevant information on the ICP Controller (including firmware version, cache size, connector assignment, termination assignment), the connected devices (e.g., firmware version, SCSI parameters, selected transfer rate, number of grown defects, last status information), the Logical Drives , Array Drives and Host Drives. Thus, it represents a very easy and effective way to create a detailed documentation of the ICP Controller(s) and disk array(s).

The Save Information file can also be very helpful for a remote diagnosis of a system. If a trained support person has a copy of this file (by fax, by email), she/he can very easily find the appropriate steps to bring the system back to full operation.

Update the ICP Controller Firmware

The firmware, the BIOS and the GDTSETUP program of the ICP Controller are stored in a Flash-RAM which is part of the ICP Controller hardware. In contrast to EPROMs, Flash-RAMs can be re-programmed many times and without the complicated UV-light erasing procedure. Thus, these software modules can be easily updated without having to remove the controller from its PCI slot. Firmware and BIOS are part of the GDT_RPFW file.
To get the latest firmware for your ICP Controller, you can visit our website at

http://www.icp-vortex.com

or our ftp server at:

ftp://ftp.icp-vortex.com/download

The file has an extension (e.g., GDT_RPFW.009) which indicates the version stepping. We recommend that you also download the packed files which contain the latest programs/drivers for the operating system used on your system. Observe the following order when carrying out the updating procedure:

- Get the latest GDT_RPFW file for the ICP Controller. The file does NOT need to be expanded !
- Format a 3.5" HD disk (1.44MB) and copy the GDT_RPFW file on this disk.
- After selecting the Firmware Update option a file dialog opens where you should specify the path (A:). A list of firmware versions (normally only one) is displayed. After selecting the new firmware and final confirmation, the new firmware is programmed into the Flash-RAM of the ICP Controller.

The new firmware becomes active after the next cold boot.

Note: All user specific settings concerning the ICP Controller and the disk arrays are not affected by the firmware update.

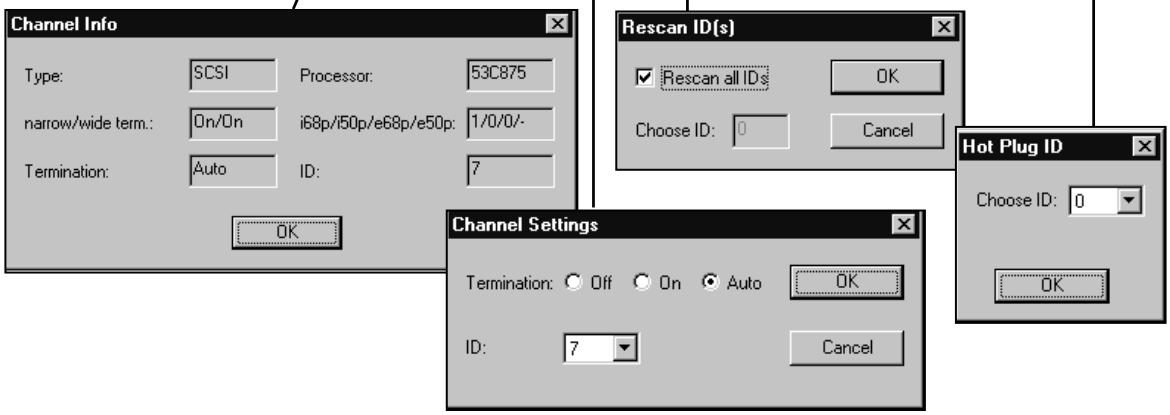
Turn off the Audible Alarm

This option allows you to turn off the audible alarm of the ICP Controller manually.
After a significant event (a drive failure or an overheat of the ICP Controller) the audible alarm of the ICP Controller is turned on. If the reason of the event is removed, the audible alarm turns off automatically.
If a member of an Array Drive has failed you should replace the failed drive as soon as possible. Read more about the fail state.
If the state of an Array Drive changes into error (more than one drive has failed) please contact our hotline for further assistance.
If no drive failed, you may also check the Controller Events to find out if the CPU of the ICP Controller is overheated.
If you hear an audible alarm, but the silence function is not offered and there are no critical controller events, check, if the alarm is coming from a different source, like the CPU cooler or the mainboard.

K.4.2 I/O Processors

These are the I/O processors of the ICP Controller. Each processor controls one I/O channel.

Icon	Description	double click opens...	right click opens...
	SCSI processor SE (**s**ingle **e**nded)	Channel Information	Change Settings Rescan ID(s) Hot Plug: Add Disk
	SCSI processor LVD/SE (**l**ow **v**oltage **d**ifferential / single ended)		
	FC processor FC AL (**f**ibre **c**hannel **a**rbitrated **l**oop)		



Channel Settings

T*ermination*
The termination for this channel of the ICP Controller can be set to three different states:
- AUTO: The termination of the lower (low byte) and upper data lines (high byte) is enabled or disabled depending on the occupied SCSI connectors of this channel.
- OFF: No lines are terminated.
- ON: All 8/16 data lines are terminated.

ID
Changes the SCSI ID of the SIOP (0-7).

Warning: The SCSI bus termination of the ICP Controller must match the existing SCSI cabling and cable termination. If the ICP Controller represents one end of the SCSI bus its termination must be ON or AUTO. If you change the termination to OFF, it is very likely that the SCSI bus is longer stable and the connected devices fail. Due to the different technology, these settings cannot be changed with an FC I/O processor (**f**ibre **c**hannel).

Rescan ID(s)

This function allows you to rescan one or all IDs of the selected SCSI channel. It displays an overview of all powered SCSI devices which are currently connected with the SCSI bus.
Warning: If the hard disk contains valid Host Drive or Array Drive information, they will be deleted when creating a new Logical Drives. All data will be lost.

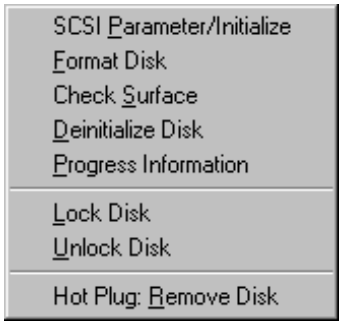
Hot Plug: Add Disk

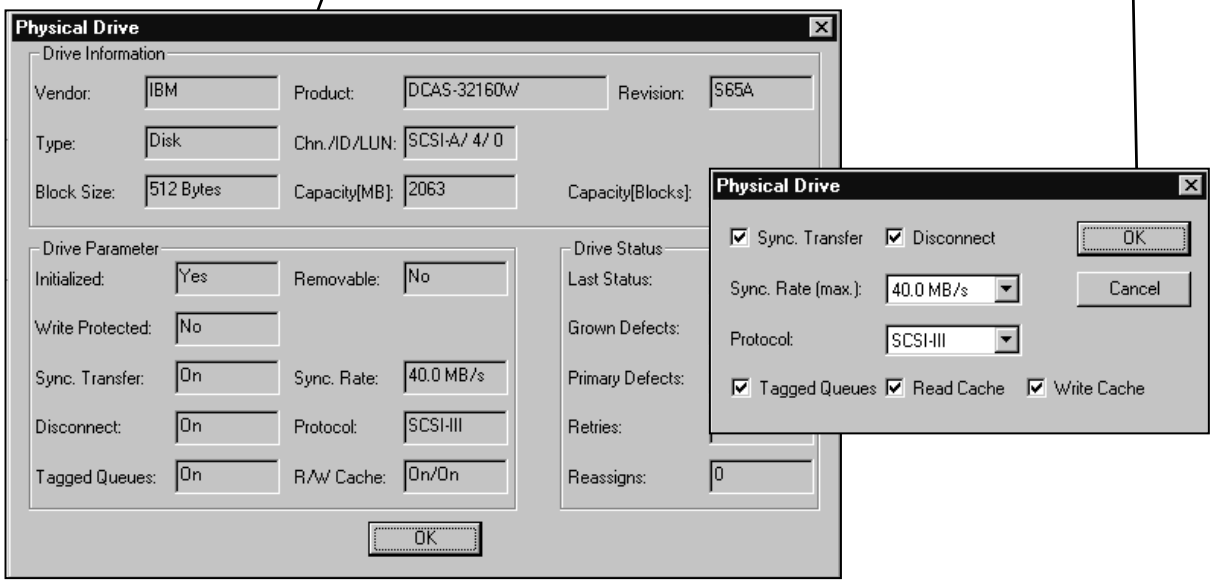
With this Hot Plug function you can add a new hard disk while the system is running. Before starting the Hot Plug procedure, you should prepare the new hard disk and set the jumpers according to the free SCSI IDs and SCSI bus termination. Thus, pay attention to the correct termination of the SCSI bus and set the ID of the hard disk to a free address, if that is not done automatically by your storage subsystem. If you do not know, which IDs are in use on the selected SCSI channel, you can find this out in the physical configuration window. Wrong SCSI bus termination and/or SCSI ID conflicts will cause a failure of the complete SCSI channel. During the Hot Plug procedure firstly enter the ID of the new hard disk (all free IDs are offered). Secondly, you have to confirm a security request. Thereafter the SCSI channel is halted. While the channel is halted, you have 45 seconds to plug in the new hard disk. (Note: Since the operating system will timeout, the channel cannot be halted longer). If you do not complete the Hot Plug procedure manually, the channel will automatically start again after 45 seconds. After the successful completion of the Hot Plug, the new Physical Drive appears in the physical configuration window. Now, you can use it to build a new Host Drive, replace a failed drive or for the expansion of an existing Array Drive. You should only use the Hot Plug function with servers and/or subsystems which are designed and certified for hot plugging of hard disks.
Warning: If the new plugged in hard disk contains valid Host Drive or Array Drive information, they will be deleted when creating a new Logical Drives. All data will be lost.

K.4.3 Direct Access Devices

Direct access devices can be initialized and subsequently used for Logical Drives. The ICP Controller caches the I/Os of these devices. Logical Drives are the components of Array Drives.

Note: If you want change the media of a removable disk during operation, the media MUST NOT BE INITIALIZED with GDTSETUP, GDTMON or the ICP RAID Navigator. Furthermore these devices have to be reserved for the raw service. Thus, the removable disk is handled like a non direct access device.

Icon	Description	double click opens...	right click opens...
	Physical Disk	Physical Drive Information	
	Removable Disk		



The SCSI Parameters

The SCSI parameters configure a Physical Drive (especially its performance). By changing the SCSI parameters, you can

- set the synchronous transfer rate
- change the settings of the hard disk cache
- enable or disable the disconnect feature
- enable or disable the tagged queues

Warning: By changing these parameters on a new hard disk or a hard disk, which has been connected with a non ICP Controller, this hard disk will be initialized and all data on this hard disk will be lost.

You can access the change SCSI Parameters / Initialize menu by clicking the right mouse button on a Physical Drive in the Physical Drives Windows (View **>** Physical Configuration)

Synchronous Transfer

Different to the older asynchronous transfer mode, the synchronous transfer offers higher transfer rates on the SCSI bus. The maximum synchronous data transfer rate depends on the width of the SCSI bus (8 bit narrow SCSI, 16 bit wide SCSI) and the frequency of the signals on the SCSI bus (10 MHz for Fast SCSI, 20 MHz for Ultra SCSI and 40 MHz for Ultra2 SCSI). The maximum data transfer rates are:

	Narrow SCSI (8Bit)	**Wide SCSI (16Bit)**	
Fast SCSI	10 MB/s	20 MB/s	
Ultra SCSI	20 MB/s	40 MB/s	
Ultra2 SCSI	-	80 MB/s	(LVD SCSI (**l**ow **v**oltage **d**ifferential) only)

Notes:
The maximum synchronous data transfer rate between a SCSI device and the ICP Controller can be limited. This limitation may become necessary if a particular SCSI cabling does not allow the maximum rate the controller and the drive could achieve.
In order to select a transfer rate above 10 MB/s the protocol has to be set to SCSI-III. Higher frequencies (single ended SCSI) require better cablings, shorter cables and a professional termination of the SCSI bus.

Disconnect

This SCSI feature enables a SCSI device to disconnect from the SCSI bus. By releasing the SCSI bus while the device doesn't need it, the bus becomes free for other devices to transfer or receive data. An example for a disconnect situation is a hard disk that needs time to read data from its media after receiving a read command. It may then disconnect from the SCSI bus so that other devices can transfer data. Later on it reconnects when it is able to deliver the data instantly. You can change the disconnect setting for a hard disk in the SCSI parameters / Initialize menu.

Tagged Queues

This feature enables modern hard disk drives to receive several commands at one time and then process them in an optimized order. Few, mainly older drives, do not or not correctly support this feature. You can change the tagged queues setting for a hard disk in the SCSI parameters / Initialize menu.

SCSI read cache / SCSI write cache

These settings enable or disable the write and read caches of the hard disks. Turning these caches off degrades the performance of the hard disk. You can change the cache settings of a drive in the SCSI parameters / Initialize menu.

Format Disk – Format a Physical Disk

Caution: This function deletes ALL DATA on the selected Physical Drive !

The hard disk which you want to low level format, may not be member of a Logical Drive if you want to start a low level format or a check surface. This function sends a format unit command to the Physical Drive. Everything else is done by the drive itself. The ICP Controller stands by to receive a good status back from the drive when it has successfully finished the low level format, thus no progress information can be shown. What the drive exactly does during the low level format and how long it takes depends on the manufacturer's format unit command implementation in the firmware of the drive, the speed and capacity of the drive. A low level format can take from seconds to hours or even days. Before you confirm to start the low level format, you are asked if you want to delete the grown defect list of the drive. Deleting this list, does not mean that the grown defects (media defects) vanish. It is very likely that the low level format will trace them again and map them out. Usually, there is no need to low level format a drive. This should be only done with a defective drive. If you want to check the surface of a hard disk, it is better to use the check surface function.

Warning: It is strongly recommended not to interrupt a low level format of a drive. This may cause an inoperable drive.

Check Surface

Caution: This function deletes ALL DATA on the selected Physical Drive !
The hard disk which you want check, may not be member of a Logical Drive. This function writes certain data patterns to the disk and reads them afterwards. Thus, media defects can be marked and mapped out into the grown defect list. The check surface function can be interrupted at any time.

Deinitialize a Physical Disk

Deinitializing a Physical Drive removes the ICP initialization sectors.
The Physical Drive may not be member of a Logical Drive if you want to deinitialize it.

Lock / Unlock a Removable Disk

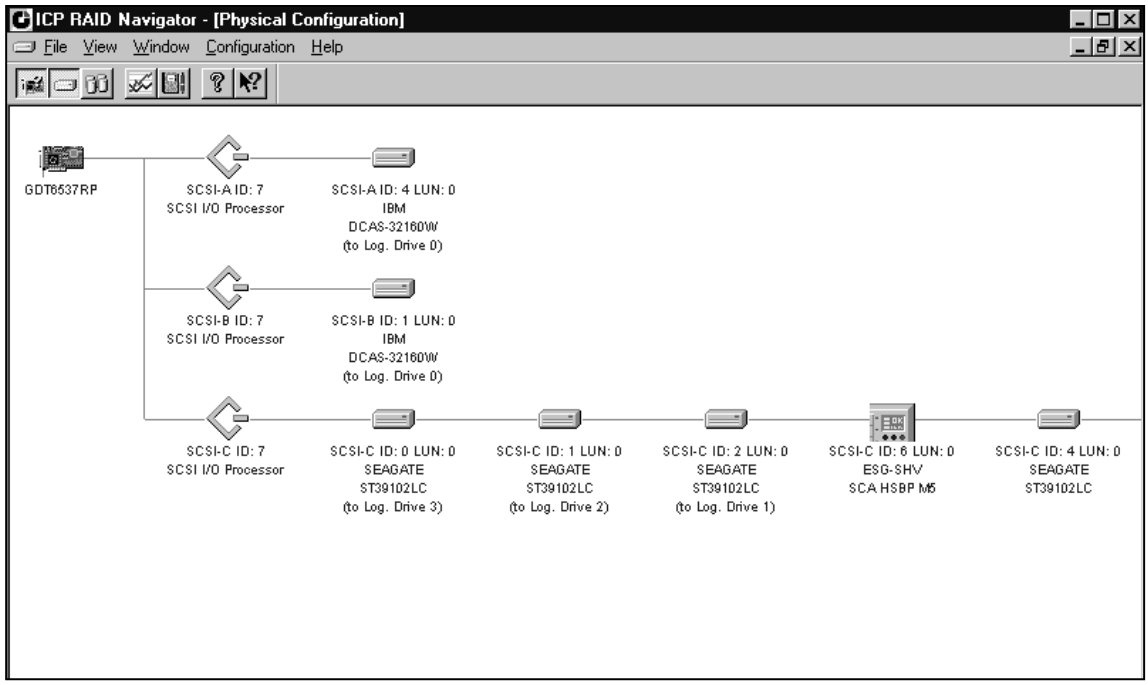
With this function you can lock or unlock a removable drive containing a removable medium. If the Physical Drive is locked, the medium cannot be ejected with the eject button while the system is running.

K.4.4 Non direct access devices (raw devices)

Non direct access devices cannot become components of Logical Drives, Array Drives or Host Drives. These devices are either controlled by a software driver (e.g. an ASPI module), the operating system or an application. Non direct access devices cannot be initialized or changed in their SCSI parameters with this program.

Icon	Description	double click opens...	
	CDROM / CDR	Physical Drive Information	
	Tape drive		
	SAF-TE-Processor		
	Scanner		
	SCSI Printer		

Example for a Physical Configuration:

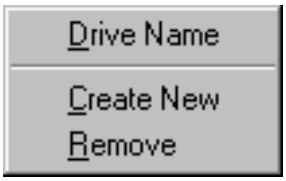


K.5 Logical Configuration Window

This window shows the logical configuration of Host Drives, Array Drives and Logical Drives controlled by the selected ICP Controller. The complete configuration is shown as a tree starting from the left with the Host Drives, followed by the Array Drives (if RAID is configured), the Logical Drives and the Physical Drives. To get detailed information on the single devices, double click on the icons. The windows that will open then, depend on the type of the device.
To change the logical configuration of the drives, click the right mouse button on the desired drive or select the suitable option from the configuration menu.

Host Drives

These are the drives "visible" to the operating system.

Icon	Description	double click opens...	right click opens...
	Host Drives	Host Drive Information	
	Create a new Host Drive	Create a new Host Drive	

Normal Host Drive
This Host Drive belongs to the selected ICP Controller on a non clustering I/O channel.

Local mounted Cluster Drive
A Cluster Drive is a Host Drive on a clustering I/O channel.
This Host Drive is mounted on the selected ICP Controller.
Clustering means that two or more servers share resources. In case of one server failing these resources move over to another valid server. The hard disks used for clustering are physically not connected with just one ICP Controller, but with several ICP Controllers in different servers (shared I/O channels).
Only one server can own a Host Drive at the same time, so a Host Drive configured for clustering may either be controlled by the selected ICP Controller (i.e., local mounted) or by a different ICP Controller (i.e., remote mounted).
You may only change the configuration of a local mounted Host Drive.

***Remote mounted* Cluster Drive**
A Cluster Drive is a Host Drive on a clustering I/O channel.
This Host Drive is mounted on an ICP Controller in a different server.
Clustering means that two or more servers share resources. In case of one server failing these resources move over to another valid server. The hard disks used for clustering are physically not connected with just one ICP Controller, but with several ICP Controllers in different servers (shared I/O channels).
Only one server can own a Host Drive at the same time, so a Host Drive configured for clustering may either be controlled by the selected ICP Controller (i.e., local mounted) or by a different ICP Controller (i.e., remote mounted).
You may only change the configuration of a local mounted Host Drive.

***Private* Host Drive *belonging to another* ICP Controller**
This is a Host Drive on a clustering I/O channel.
This Host Drive is configured as a Private Host Drive and does not belong to the selected ICP Controller.
Clustering means that two or more servers share resources. In case of one server failing these resources move over to another valid server. The hard disks used for clustering are physically not connected with just one ICP Controller, but with several ICP Controllers in different servers (shared I/O channels).
Usually, when booting a cluster, the ICP Controller starting up first will gain control over all Host Drives on the clustering I/O channels. If you want to be sure that a Host Drive is controlled by a specific server, you may configure this Host Drive as a Private Host Drive. A Private Host Drive cannot be used for clustering anymore.
Note: You cannot change the configuration of a Private Host Drive which is not property of the selected ICP Controller. You have to use GDTSETUP to change its configuration.
A Private Host Drive belonging to the selected ICP Controller will be displayed like a normal Host Drive.

Array Drives

Array Drives or RAID drives consist of Logical Drives. They can be fault tolerant, depending on the RAID level. The RAID level is displayed under the Array Drive icon.
Click on the icons to get more information on the different states of an array.

Icon	*Description*	*double click opens...*	*right click opens...*
	RAID 4/5/10	Array Drive Information	
	Idle		
	Build		
	Ready		
	Fail		
	Error		

 	RAID 1 Build Ready Fail		
	RAID 0		

Logical Drives

Logical Drives consist of one or more Physical Drives.

Icon	Description	double click opens...	right click opens...
   	Single Disk Hot Fix Drive Failed / missing Hot Fix or Single Disk Chaining Drive	Logical Drive Information	

Physical Drives

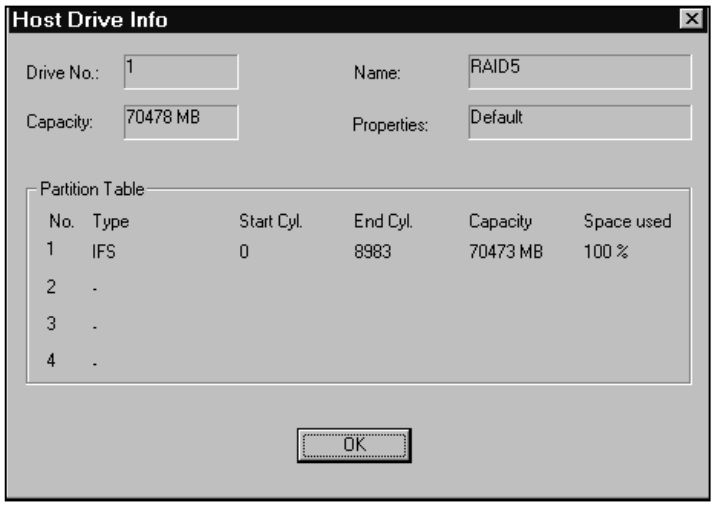
These are the hard disks. You cannot change any settings here. If you want to change the settings, you have to do this in the physical configuration window.

	Physical Disk	You can't change the disk settings here. Use the Physical Configuration window instead.

K.5.1 The Host Drive Information Window

Double click on the Host Drive icon.
This window contains information on a Host Drive like the Host Drive's capacity and a possible partition table.

Drive No	The Host Drive number of the Host Drive. The Host Drives are reported to the system one after the other, beginning with the lowest Drive Number. If the corresponding ICP Controller is the first controller in the system, the system will boot from the Host Drive with the lowest number.
Name	The name of the Host Drive. A Host Drive is automatically given a name during the configuration. It can be renamed by selecting the menu Drive Name of the menu list you get after clicking with the right mouse button on the Host Drive icon.
Capacity	The capacity reported to the operating system. The size of a Host Drive can be smaller than the size of the Logical Drive or the Array Drive the Host Drive is a part of.
Partition Table	The partition table of a Host Drive can contain up to four partition entries. Information on the type of the partition, it's location on the Host Drive, it's size and the percentage of space used by this partition are shown.



K.5.2 The Array Drive Information Window

Double click on the Array Drive Icon.
This window shows information on an Array Drive (i.e., a disk array).

Drive No	The logical number of the Array Drive.
Drive Name	The name of the Array Drive.
Type	This is the RAID level of the Array Drive. It can be RAID 0 (data striping, no redundancy), RAID1 (mirroring), RAID 4 (striping with parity drive), RAID 5 (striping with striped parity) or RAID 10 (combination of RAID 1 and RAID 0).
Status	The status of an array can be ready (operational), fail (one drive missing, still operational but not redundant), error (more than one drive failed, not operational), rebuild (one drive is being integrated), build (initial preparation of the array), idle (new defined array, before build process has started), expand (one or several

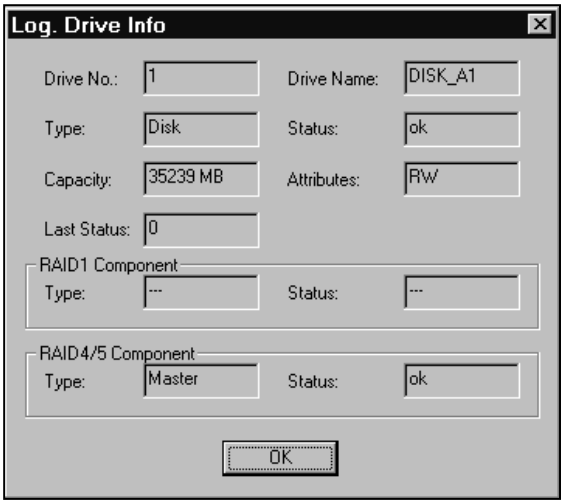
	drives are added online to the Array Drive).
Capacity	This is the capacity available for the corresponding Host Drives.
Attributes	The attribute of an Array Drive is usually read/write ([RW]). If a component of a disk array is missing while startup and the operator decides not to activate fail mode, the array is set to the read only attribute ([RO]). When the missing drive is available again, the Array Drive shows again the ready status (i.e., attribute [RW]).
Striping Size (RAID 0, 5, 10)	Data written on RAID 0, 4, 5 or RAID 10 drives is distributed over all drives (striping). This is the size of the blocks. The striping size can only be changed when the drive is created (standard setting is 32KB).
Invalid/Missing (RAID 1)	These two values show the number of invalid/missing drives. While the build is in progress (initial copy of data from the Master to the Slave), invalid drives exist (the drives are updated).
Pool Hot Fix	Indicates, if the Pool Hot Fix access is enabled or disabled. A Pool Hot Fix Drive is a spare drive within the so-called Hot Fix Pool. A drive in a Hot Fix Pool is available for several Array Drives as a Hot Fix drive (assuming it has an appropriate capacity). Thus, several Array Drives can share one Hot Fix drive. Of course, once this drive has been used by one of the Array Drives, it is no longer available for the others. Hot Fix Drives can also be configured as Private Hot Fix Drives. A Private Hot Fix Drive can only be used by the Array Drive it was configured for. The Pool Hot Fix access can be changed by clicking with the right mouse button on the Array Drive icon.

K.5.3 The Logical Drive Information Window

Double click on the Logical Drive icon. This window shows information on a Logical Drive. A Logical Drive can be either a single disk, or a chaining group of disks (concatenation), or a stripe set of several disks.

Drive No	The number of the Logical Drive.
Drive Name	The name of the Logical Drive.
Type	The type of the Logical Drive. A Logical Drive can be either a single disk, or a chaining group of disks (concatenation), or a stripe set of several disks.
Status	This is the state of the Logical Drive. It can be ready, missing (not available after reset) or failed (i.e., no longer available for the controller).
Capacity	The capacity which is available for Array Drives or Host Drives.
Attributes	The attribute of a Logical Drive is usually read/write ([RW]). If a component of a disk array is missing while startup and the operator decides not to activate fail mode, the array is set to the read only attribute ([RO]). When the missing drive is available again, the Array Drive shows again the ready status (i.e., attribute [RW]).

Last Status	The last status information of a Logical Drive. This is different to the last status information of Physical Drives.
RAID 1 Component	If the Logical Drive is a member of a RAID 1 array, it can be either master or slave. If a RAID 1 component is added to a Logical Drive, the data is read from the master and written to the added Logical Drive (the slave). One master may have several slaves.
RAID 4/5 Component	As a member of a RAID 4 or RAID 5 array a Logical Drive can be the master or a component. Different to RAID 1 arrays, this is only important for the internal structure of the array.



K.5.4 Change the name of a Drive

Click the right mouse button on the drive icon.
This menu option opens a dialog where you can enter a new name for the selected drive (up to 7 characters).

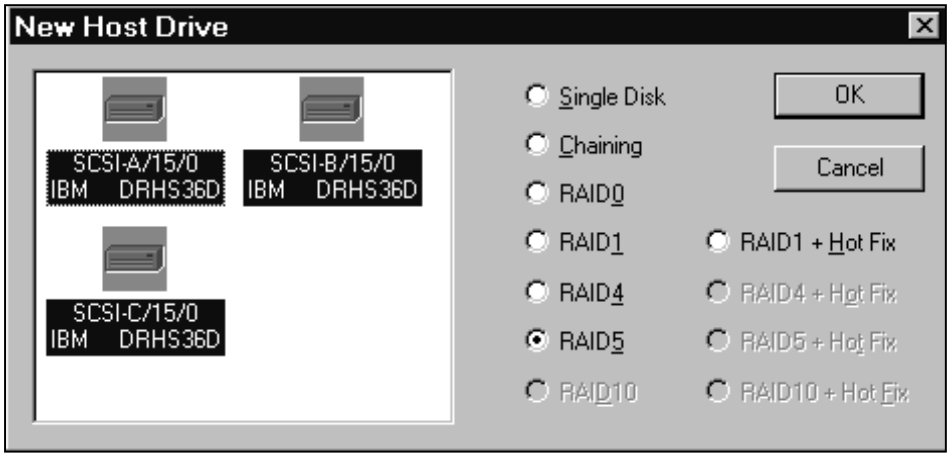
K.5.5 Remove a Host Drive

Click the right mouse button on the Host Drive icon. By selecting this menu item you can delete a Host Drive.
CAUTION !
By deleting a Host Drive, all other Host Drives which are part of the same Array Drive or Logical Drive, the Array Drive or Logical Drive itself and all its components are deleted ! ALL DATA WILL BE LOST.
To prevent the operating system from crashing and to hinder the unintentional deletion of drives all partitions on the Host Drive (and it's related Host Drives if it is split into several Host Drives) must be deleted before the Host Drive can be removed.

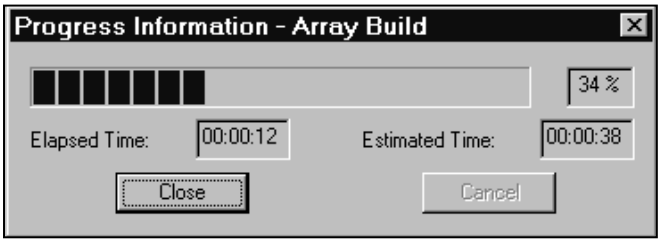
K.5.6 Create a new Host Drive

Double click on the new Host Drive icon. Only the Host Drives are "visible" for the operating system.
The structure of the Host Drives is not known to the operating system i.e., the operating system does not recognize that a given Host Drive consists of a number of hard disks forming a disk array. To the operating system this Host Drive simply appears as one single hard disk with the capacity of the disk array. This complete transparency represents the easiest way to operate disk arrays under any operating system, neither operating system nor the computer need to be involved in the administration of these complex disk array configurations. To create a new Host Drive, you need one or more Physical Drives which are

not yet part of another Host Drive. After double clicking on the New Host Drive icon a new window opens.



On the left side you see a box with the available Physical Drives, under the drives you can see their physical coordinates (channel/ID/LUN), the manufacturer and the vendor-unique name.
On the right side you see a list of all possible Host Drive types which can be configured. When there is no Physical Drive selected in the left box, all possibilities are disabled (gray). While you are selecting Physical Drives for the new Host Drive, more and more possibilities become selectable.
You can select a single Physical Drive by clicking on it. If you want to select more than one Physical Drive, simply draw a frame around the Physical Drives, or press the <ctrl> key and then click on all the Physical Drives you want to combine to a new array.
When you have finished the selection of the Physical Drives, choose the type of Host Drive you want to create and click on OK.
If the selected Host Drive uses data striping (RAID 0, 4, 5 or 10) you can change the default striping size. If you have selected a configuration with Hot Fix Drives, you can choose between a Private Hot Fix Drive or a Pool Hot Fix Drive. After the Host Drive was created, you can partition and format the Host Drive with the corresponding operating system utility.
If an array build started, you can monitor the progress of the array build by clicking the right mouse button on the Host Drive and then selecting progress information.



K.5.7 Parity Verify

Click the right mouse button on the Array Drive icon.
RAID 4 and RAID 5 drives contain parity information, which is used in case of a drive failure. The parity information is calculated from the user data on the disk array. On RAID 4 disk arrays the parity data is stored on a single disk (parity disk), on RAID 5 disk arrays the parity data is being distributed over all drives (parity striping). This option verifies online the parity information of the selected RAID 4 or RAID 5 Array Drive. If this option is selected for several Array Drives, the processes are put into a queue and performed one after the other.

If a parity error is detected, you should try to find the reason for this data corruption. A good indication for data corruption can be retries on the SCSI bus. If the retry-counter shows high numbers, this might be the problem. Possible reasons for parity error are bad cabling or termination or a hardware error like a defective drive or a drive which is overheated. **After** removing the reason of the data corruption you can carry out parity recalculate to ensure that the parity information of this disk array becomes again valid.

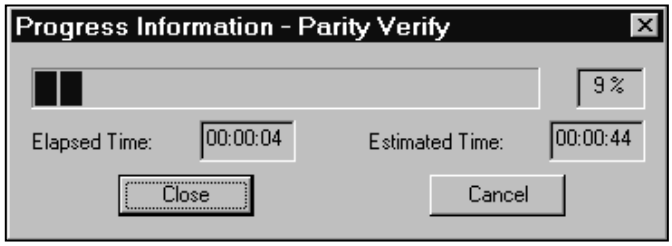
K.5.8 Parity Recalculate

Click the right mouse button on the Array Drive icon.
A parity recalculate can be used to repair parity errors which have been previously detected with a parity verify. A parity recalculation initiates the same process as used for a build on an Array Drive. The user data on the drives is read, parity information is calculated from this user data and the parity information is written anew.
While the parity recalculate is in progress the array is in the build state. During this time the Array Drive is not redundant. You can view the progress of the build process by when you click the right mouse button on the Array Drive icon and select progress information.
After the parity recalculate is completed the Array Drive's state changes again into ready with the addition '/patch'. This notification has no relevance for the operation of the Array Drive but is a reminder that the parity information of this Array Drive has been recalculated once.

K.5.9 Progress Information

Click the right mouse button on the Array Drive or Physical Drive icons.

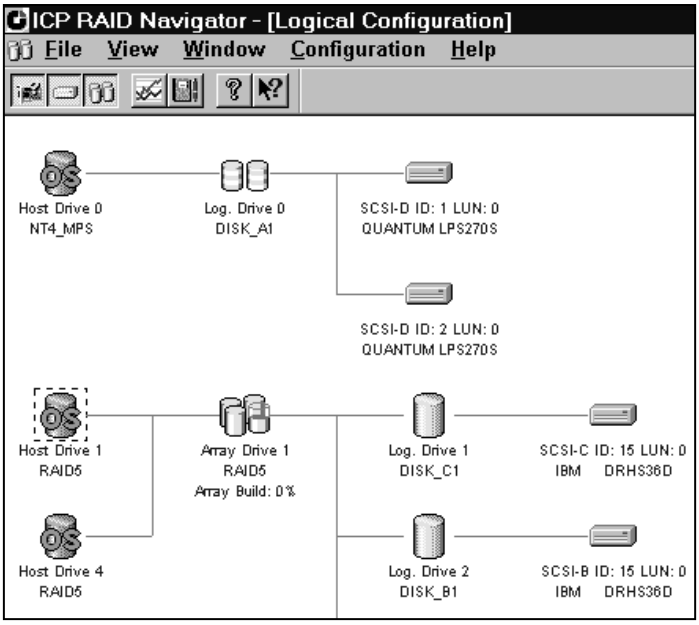
The progress information window shows the progress (elapsed time, estimated time, percentage of completion) of a parity verify, a disk array build or a surface check. During an Array Drive rebuild, the information (user data and/or parity) of a specific Logical Drive is calculated from the user data and parity information of the other Logical Drives and written to this new Logical Drive. During a build of an Array Drive parity information is calculated and written to a specific Logical Drive (RAID 1/4) or striped over the Array Drive (RAID 5). The estimated time indicates the time needed by the controller to finish this process if the user load on the controller does not change. The elapsed time is reset when opening the window.



K.5.10 Expansion of an Array

Click the right mouse button on the Array Drive icon.
There are two fundamental functions which are available within this option:
Migrate the RAID level of the selected RAID Array Drive (RAID 0-> RAID 4 and vice versa, RAID 0 -> RAID 5 and vice versa) and/or
Expand the capacity of the selected Array Drive by adding one or several new hard disks.

Both functions can be selected at the same time. E.g., migrate from RAID 0 to RAID 5 and add a new drive. To initiate a migration or expansion with a RAID 4/5 Array Drive, the state must be ready. The data on the Array Drive remain intact and are not affected by the expansion. The additional capacity is introduced as new Host Drive. If a Logical Drive fails during the expansion, the expansion process continues until the expansion is finished. The Array Drive changes into the fail state. The new capacity is available as a new Host Drive. Windows NT (Tool: Disk Administrator) and Novell NetWare ("Scan for new Devices" and then Tool: Install) allow the online integration of new disk capacity. Depending on the RAID level the current Array Drive has, selecting a different one here, will cause the Migration of the RAID level of the Array Drive. If you select the same RAID level, the following procedure will expand the capacity of the Array Drive, only.

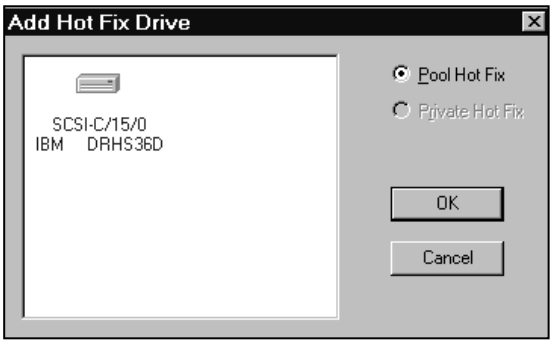


If you want to add additional drives to the Array Drive, select them from the box on the left side of the window. It is possible to add more than one drive at the same time.
If no Physical Drives are offered, you have to use the Hot Plug: Add Disk function first, to add new drives. If you have previously limited the capacity of the Array Drive, you are asked, if you want to convert this free space to a new Host Drive. You can open the progress information window to monitor the progress of the expansion.

IMPORTANT: Before starting an expansion it is absolutely necessary to verify that you have a valid backup of the complete data on the system. The expansion process includes a new, unknown hard disk. If there are problems with this disk or with the cabling of this disk there is always the risk of data loss. Some expansions will take quite a long time, so it is advisable that there is not too much traffic (i.e., user load) on the system, otherwise an expansion of a large Array Drive can easily take days.

K.5.11 Add a Hot Fix Drive

Click the right mouse button on the Array Drive icon.
Use this option to add a Hot Fix Drive to an Array Drive (RAID 1/4/5/10). You can choose if you want to add a Private Hot Fix Drive or a Pool Hot Fix Drive. Private Hot Fix Drives are assigned to a specific Array Drive and are activated if a member of this Array Drive fails. Pool Hot Fix Drives can be used by any Array Drive with enabled Pool Hot Fix Access. RAID 1 Array Drives allow only Pool Hot Fix Drives. After choosing the type of Hot Fix Drive you can select a Physical Drive from the box which shows all suitable drives.



The capacity of the Hot Fix Drive has to be larger or equal than the capacity of the components of the Array Drive (Example: The Logical Drives of the Array Drive have 4.2GB capacity, thus the capacity of the Hot Fix Drive has to be 4.2GB or larger).
The spindle motor of the Hot Fix Drive is normally (i.e., when the Hot Fix Drive is not needed) stopped. Thus, it may take a few seconds until you get a response, if you click on that drive.

Some general notes on Hot Fix Drives.
One of the reasons that have led you to choose RAID disk arrays definitely lies with the redundancy, that is, the data security you still preserve even in the event of disk failure, thus resting assured against loss of data and time. Hot Fix Drives are possible with all RAID 1, 4, 5 and 10 disk arrays. In order to assist the following considerations, we define the term time without redundancy, TWR. Set apart the time needed to set up the disk array (state build), the time without redundancy should be kept as short as possible. Let us assume that one of the hard disks of the RAID 5 disk array we set up with example 1 fails. The disk array is without redundancy. TWR starts to run. Any superfluous prolongation of the TWR (because you have to get a replacement drive, or because you did not realize the failure immediately since you didn't hear the ICP Controller's alarm signal, or because nobody checked the file server) increases the risk of data loss which will occur if a second drive should fail. Therefore, new redundancy should be created as soon as possible and in an entirely automated manner. Integrating a Hot Fix Drive as an immediately available and auto-replacing drive is the only way to keep the TWR as short as possible. Only a Hot Fix drive can ensure optimal disk array security and constant data availability. Of course a Hot Fix Drive is not compulsory. If you control the disk array at regular intervals and immediately replace a defective drive (by shutting down the system or hot-plugging), you can do without a Hot Fix Drive.

K.5.12 Remove a Hot Fix Drive

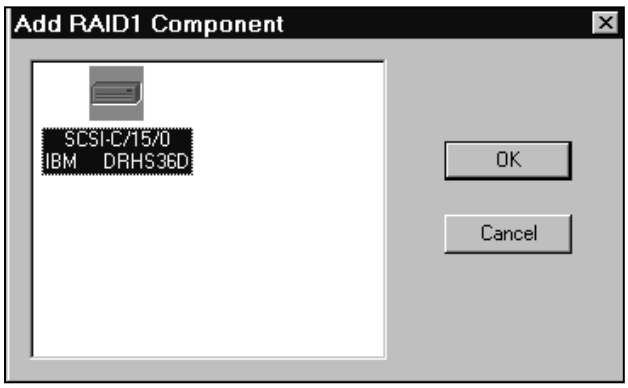
Click the right mouse button on the Array Drive icon.
This option opens a box showing available Hot Fix Drives. Here you can select the Hot Fix Drive you want to remove from the Array Drive and then confirm your selection. You can remove any Pool Hot Fix Drives or the Private Hot Fix Drive of the selected Array Drive.

K.5.13 Hot Fix Pool Access

Click the right mouse button on the Array Drive icon.
Here you can enable or disable the access of an Array Drive to the pool of Hot Fix Drives. If the access is enabled this means that if a member of an Array Drive fails, a drive can be taken from the Hot Fix Pool and build automatically into the Array Drive. To be able to activate this feature, there must be suitable Logical Drives in the Hot Fix Pool. You can add drives to the Hot Fix Pool with the function Add Hot Fix Drives. By doing so, the Hot Fix Pool access for this specific Array Drive is activated automatically. For all other Arrays Drive you have to activate the access manually.

K.5.14 Add a RAID 1 Component (Mirror a Drive)

Click the right mouse button on the Logical Drive icon.
In certain "emergency" cases this is a very powerful and helpful option. This function allows you to add to a Logical Drive which is member of an Array Drive, another Logical Drive as a mirror drive (RAID 1).
Example: You have configured an Array Drive with 4 Logical Drives. One Logical Drive has failed and the Array Drive went into the fail state. Another failure would cause data loss. Unfortunately, you find another Logical Drive, which is shortly before failing (e.g., you hear a strange noise from it, or it's grown defect counter explodes). If you now initiate a hot plug it is very likely that this critical Logical Drive will also fail. This would result in a disaster. To avoid that problem, you can mirror in a first step a new good Logical Drive to the critical one. When the copying is finished you remove the critical Logical Drive and then carry out a hot plug procedure.



To add a RAID 1 component you need to select in a first step a Logical Drive, the master. All suitable Logical Drives (with a capacity equal of larger than the capacity of the master) are shown in a box. Now choose the Logical Drive you want to add, the slave. After confirming, a new RAID 1 Array Drive is build, i.e., all data from the master are copied to the slave drive(s). When this process is finished all Logical Drives in the RAID 1 Array Drive are identical (there is no longer a difference between master and slave).

K.5.15 Remove a RAID 1 Component (Remove a Mirror Drive)

Click the right mouse button on the Logical Drive icon.
Here you can remove a drive from a RAID 1 Array Drive. If the Array Drive is in the build or in the fail state, you may only remove invalid RAID 1 components.
To remove a Logical Drive from a RAID 1 Array Drive you have to select the Logical Drive you want to remove. This is done by selecting a Logical Drive from a box where you see all members of the RAID 1 Array Drive . After confirmation the Logical Drive is removed. If the RAID 1 Array Drive consists of two drives (like usual) the RAID 1 Array Drive disappears and only one Logical Drive will be left. You can create a new RAID 1 Array Drive by selecting add RAID 1.

K.5.16 Replace a Logical Drive

Click the right mouse button on the Logical Drive icon.
If a Logical Drive of an Array Drive without a Hot Fix Drive should fail (or is very likely to fail, soon), you should replace the defective hard disk with a new one as soon as possible, because the Array Drive is without redundancy. The replacement Logical Drive has to have at least the same capacity as the failed one. The replacement is carried out either interactively with GDTSETUP or online with the GDTMON utility program or the ICP RAID Navigator. Before the Logical Drive can be removed, you have to select a new Logical Drive from the box with available Physical Drives which is shown after this option is selected. If no Physical Drive is offered, you have to use the Hot Plug: Replace Drive function to add a new drive. After the confirmation, the old Logical Drive is removed. Next, the data is rebuild on the new Logical Drive. During this process the array is in the rebuild state and therefore not redundant.

K.5.17 The Different States of an Array Drive

The ready state

 RAID 1  RAID 4/5

The Array Drive is fully operational when in the ready state. All redundant information is present, that is, a hard disk can fail without impairing the functionality of the Array Drive. This is the normal state of an Array Drive. The state ready/expand indicates, that the RAID level and/or capacity are currently migrated/expanded.

The idle state

 RAID 4/5

This state is characterized by the fact that the redundant information of the Array Drive has never been entirely created. The Array Drive is in this state after its first configuration. If an error should occur while the array is in the build state, the array returns to the idle state (exception: if during build mode the dedicated drive of a RAID 4 Array Drive fails, the state changes to fail).

The build / rebuild state

 RAID 1  RAID 4/5

After the Array Drive has been configured for the first time, and the build process is started it assumes the build state. While the Array Drive is in the build state, redundancy information is calculated and stored to the components of the Array Drive.
The disk array will assume the rebuild state after the automatic activation of a Hot Fix Drive or after a manual replacement (Hot Plug). The data and the redundant information are reconstructed and stored to the new drive.
In both states, the Array Drive is not redundant.
You can monitor the progress of the array build/rebuild by clicking the right mouse button on the Host Drive and then selecting progress information.
Note: User traffic on an Array Drive which is in the build/rebuild state, slows down the build/rebuild process.

The fail state

 RAID 1  RAID 4/5

The Array Drive changes to the fail state whenever a Logical Drive fails. Redundancy information is still present, thus allowing the remaining hard disks to continue working. This state should be eliminated as soon as possible by replacing the defective hard disk. This can be done by using a Physical Drive, which is already connected with the controller, but not yet used for a Logical Drive, with the replace drive function, or by using the Hot Plug Replace Drive function. If a Hot Fix Drive has previously been assigned to an Array Drive, the ICP Controller will automatically replace the defective drive and start the reconstruction of the data and the redundant information. Therefore, under these circumstances the fail state is only temporary and will be eliminated by the controller itself.

Whenever an Array Drive enters a fail state, the ICP Controller's audible alarm is turned on. You can silence the audible alarm in the physical configuration window.

To analyze the reason for the drive failure, the last status from the Physical Drive information is very helpful. Additionally you should check for retries and/or reassigns.
A drive failure may also be the result of bad cabling, wrong termination or overheating.

The error state

 RAID 4/5

If a second hard disk should fail while the Array Drive is in the fail or rebuild state, it is not possible to continue the working session without restrictions. The disk array is still available for I/Os, but data loss and error messages on the host level are possible.
Usually you have to remove the Array Drive and build a new one. In some situations (see below) there might be still a chance to reset the array. Please contact our support departments.

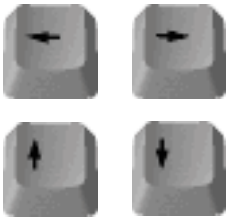
To find out why the drives failed, the last status from the Physical Drive information is very helpful. Additionally you should check for retries and / or reassigns.
A drive failure may also be the result of bad or cabling, wrong termination or overheating.

Some of these states may become the addendum ***patch*** (e.g. build/patch, ready/patch). This word indicates that the original Array Drive went through a significant procedure. I.e., the parity information was recalculated anew. Or, the Array Drive has been patched from the error state into the fail state. This may become extremely helpful in a situation where two Logical Drives of an Array Drive, fail at the same time, but only one of the two Logical Drives is really defective and the other was blocked out, since it was connected with the same I/O channel as the defective one. The Array Drive's state is error and normally all data would be lost. The ICP Controllers include some functions, which allow the patch of this Array Drive from the error state into the fail sate. Before the actual patch, the defective drive has to be physically removed from the Array Drive. Such a patch-procedure is a real sheet-anchor and should only be used, after a detailed consultation with a trained support person (a printout of the Save Information file, is extremely helpful).

K.6 The Statistics Window

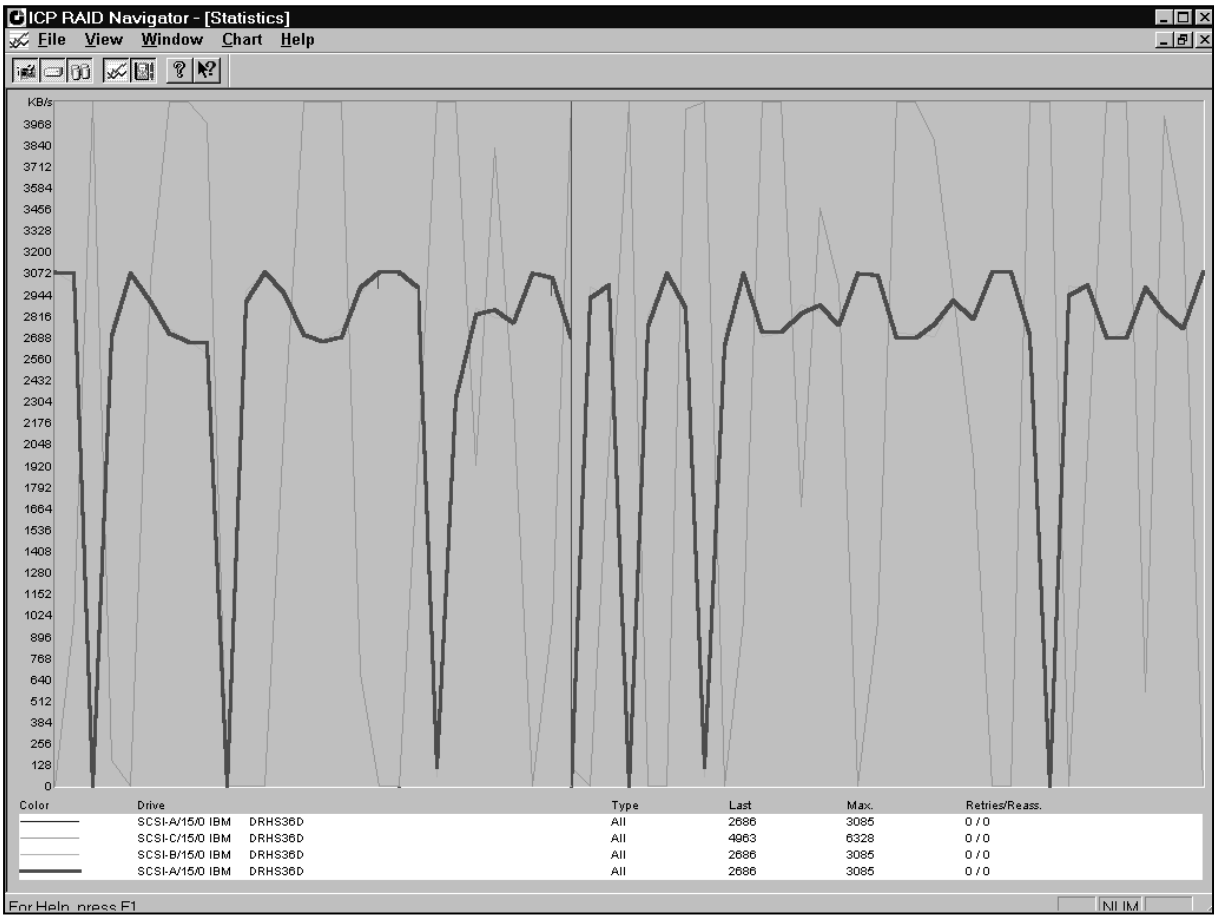
The statistics window can display the throughput of Physical, Logical and Host Drives. The vertical axis show the throughput, the horizontal axis the time. You can add drives by drag and drop them from the physical and logical configuration windows into the statistics window. If you want to change the layout of the lines, adjust the scales of the axis or remove drives from the statistics windows, you can do this using the chart menu.

You can scale the statistics window using the cursor keys:



scale time down/up

scale throughput

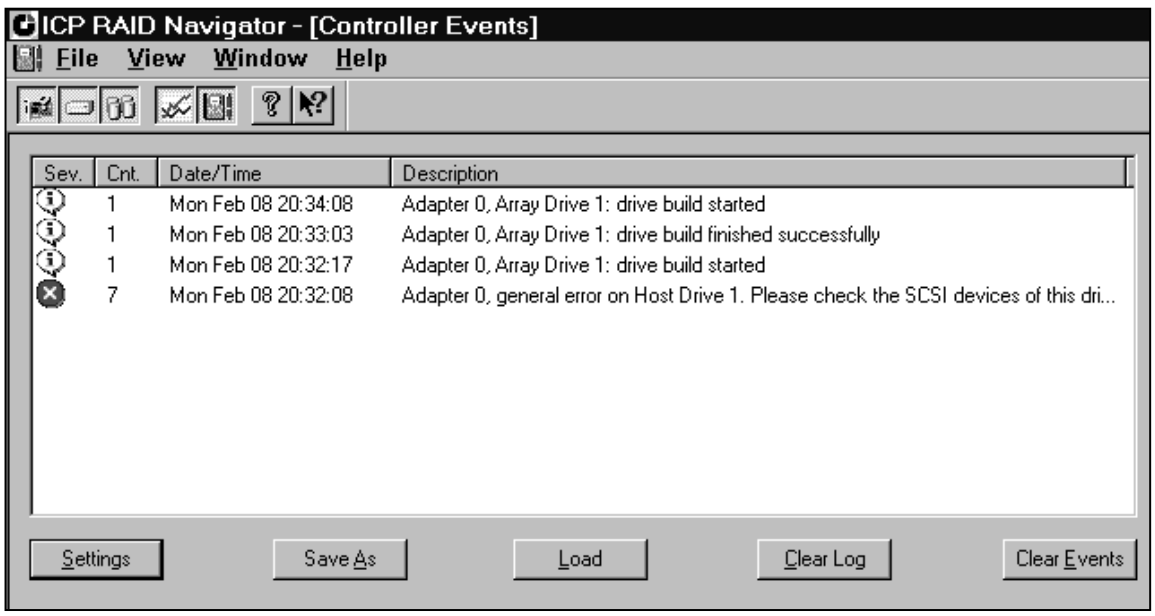


K.7 The Controller Events Window

This window shows the history of the events that occurred since the log was cleared the last time. The first column in this window contains icons representing the severity of the events:

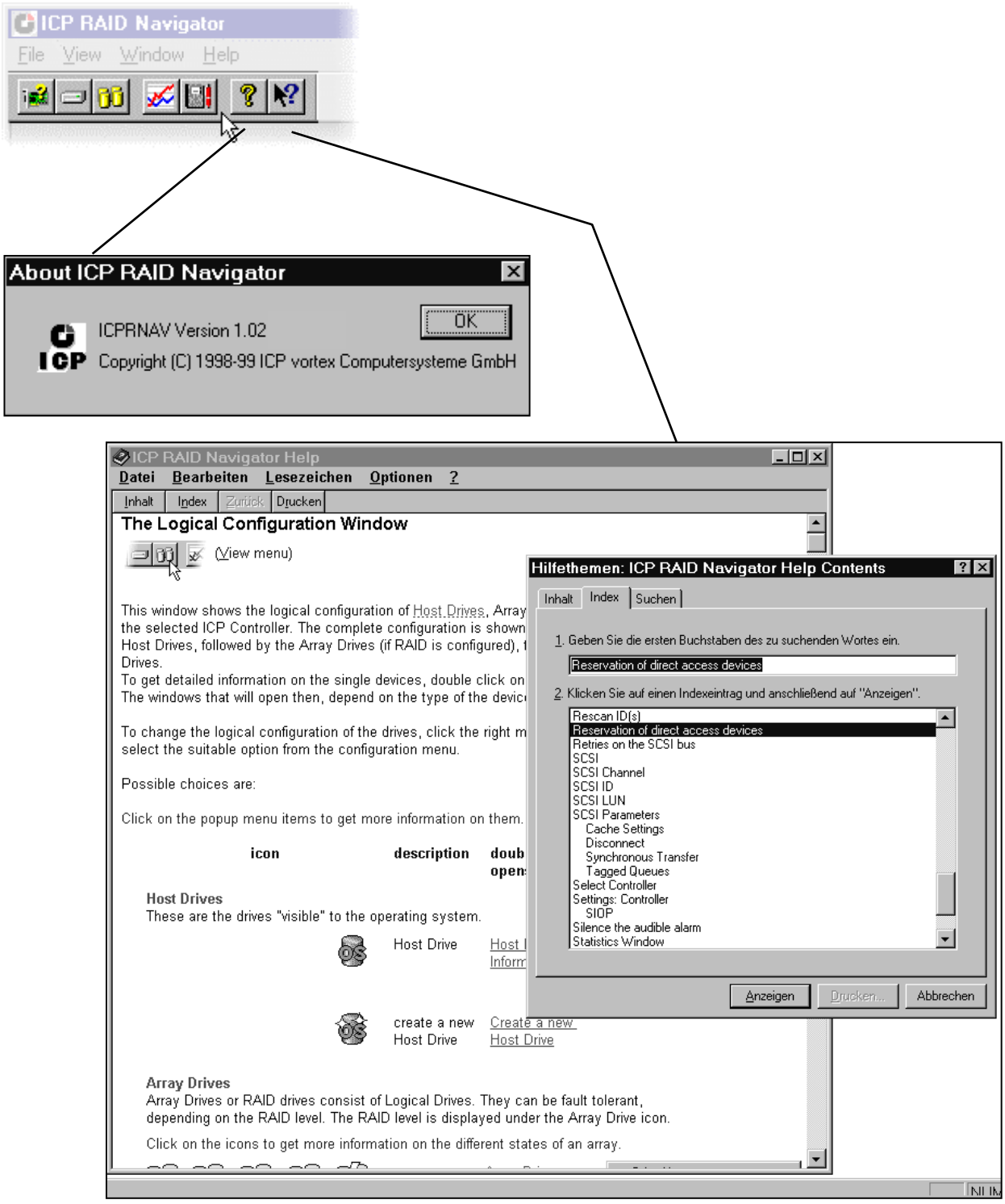
Icon	Description
	Information: This event is not critical. It only informs the system administrator about certain events, like the completion of an array build.
	Warning: This event is critical an may not be ignored. It occurs for example if an Array Drive's state changes from ready to fail.
	Error: An error occurred. This might be the failure of a drive.

The second column lists how often this event occurred. Some events may occur quite often, so this counter helps to keep an overview. The next column lists the date and the time when the event occurred. The last column describes the event. At the bottom of the window there is the Settings button. Here you can change the polling interval and enable the auto save function. Logs that are not saved on the hard disk are lost when the system is reset. The auto save function saves the current log in the time intervals selected there. The default name for this logfile is 'gdtevt.evt'. The Save As button allows you to write the contents of the event log to a specific file on the hard disk. The Load button loads an older event log and displays it. The last two buttons delete the log file and clear the event buffer on the ICP Controller.



K.8 ICP RAID Navigator Help

The ICP RAID Navigator includes an online help function. You can either choose the Help menu or the pointer with the question mark to obtain online help on a specific icon or function. There is also an index which allows you to search for certain keywords and/or topics.



K.9 ICP Service and ICP Mail

There are further powerful tools which are part of the ICP RAID Navigator delivery:

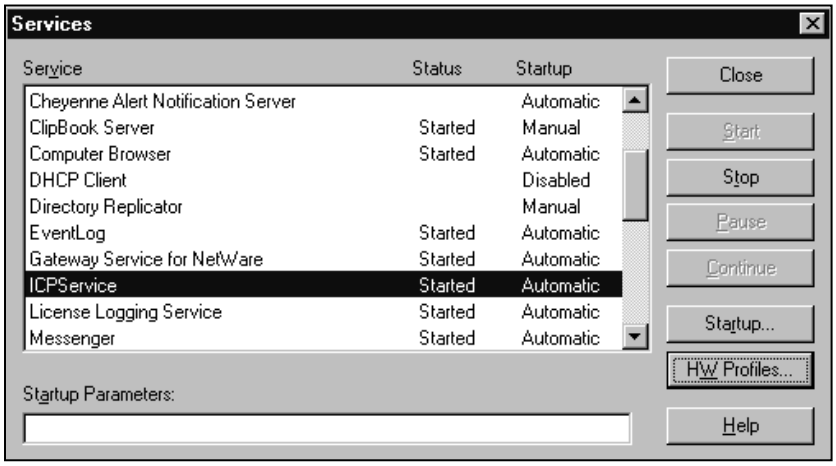
ICP Service	Allows remote access to an ICP Controller in a Windows NT server
ICP CTRLSRV	Allows remote access to an ICP Controller in a Novell Server
ICP Mail	Converts ICP messages into standard mails (for Windows 9x/NT, MAPI format)

It is recommended to install the ICP Service / ICP CTRLSRV and the ICP Mail tool on each server which is equipped with an ICP Controller. Thus, remote access to ICP Controllers in a network can be easily managed from one or several authorized users.

To install the ICP Service under Windows NT, copy ICPSRV.EXE and ICPSRV.CPL into the winnt\system32 directory and load

..\ICPSRV -i

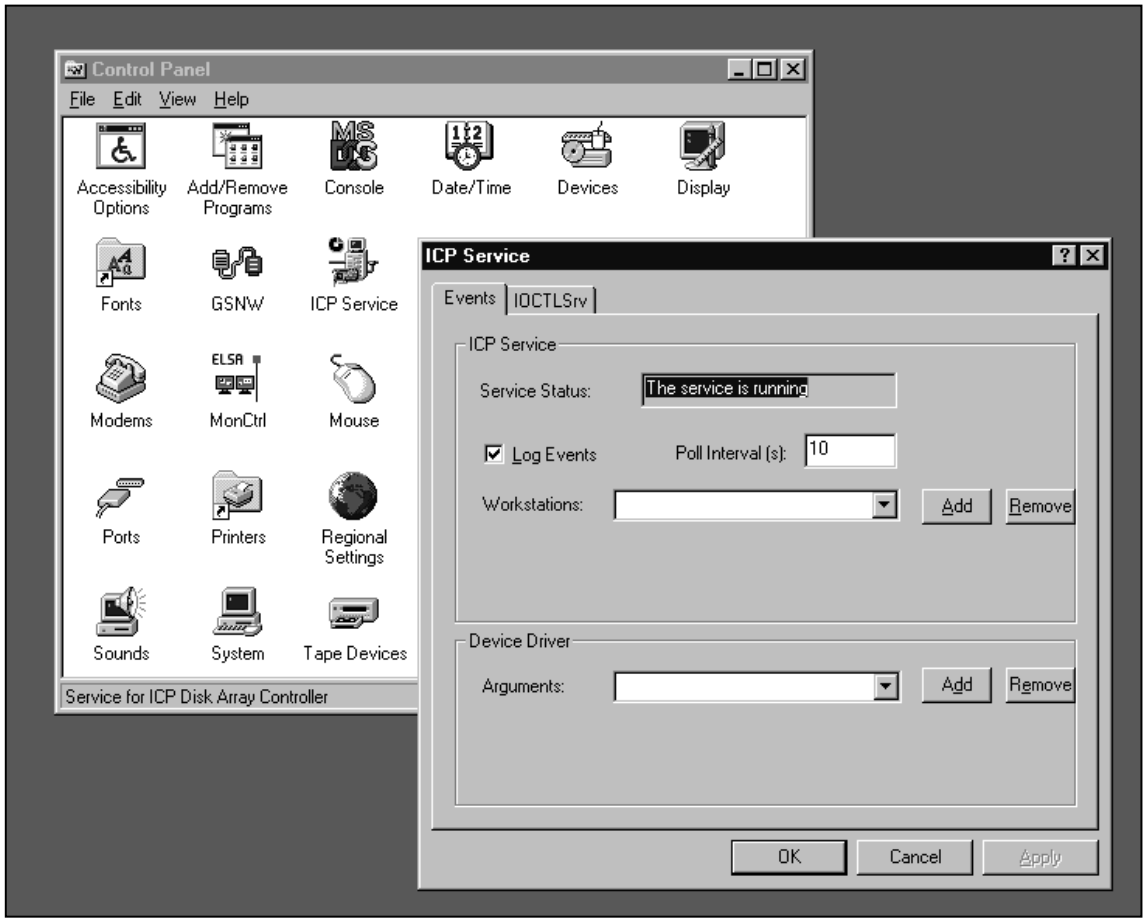
from the command line. This installs the service. In a next step load in the "control panel" the "services" program and activate the ICP Service with the Start button.



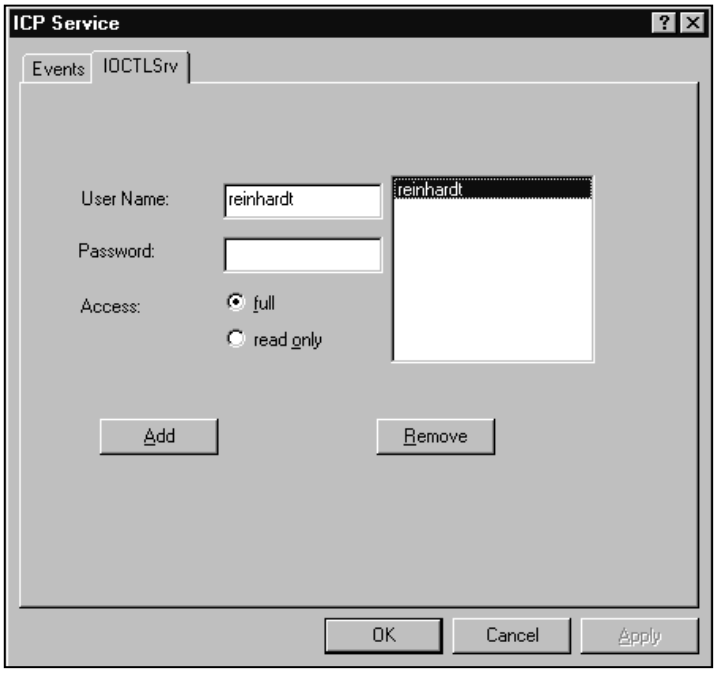
If you want to start the ICP Service during every new boot of the system automatically, click on the Startup button.

To configure the ICP Service double click on the ICP Service icon:

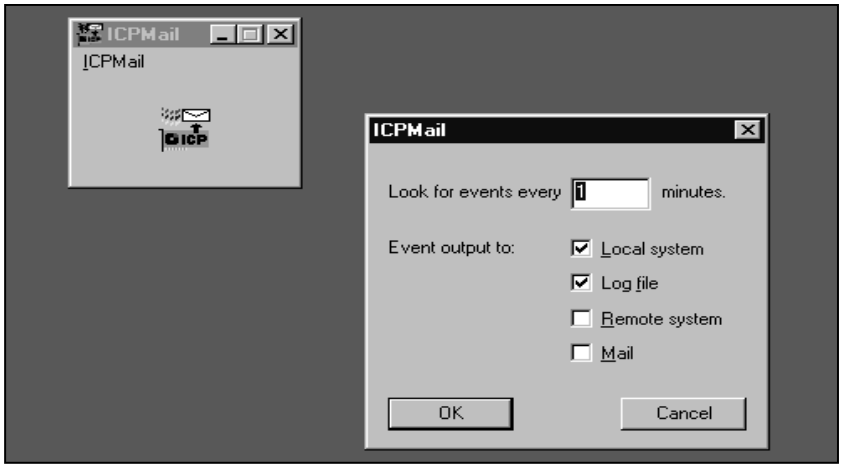
- The Poll-Interval determines the time between two message acquisitions of the ICP Service.
- Under Workstation you can add workstations which receive broadcast messages from the ICP Controller.
- In the device driver section you can add or remove parameters for the gdtx.sys driver (e.g., reserve parameters for raw devices).



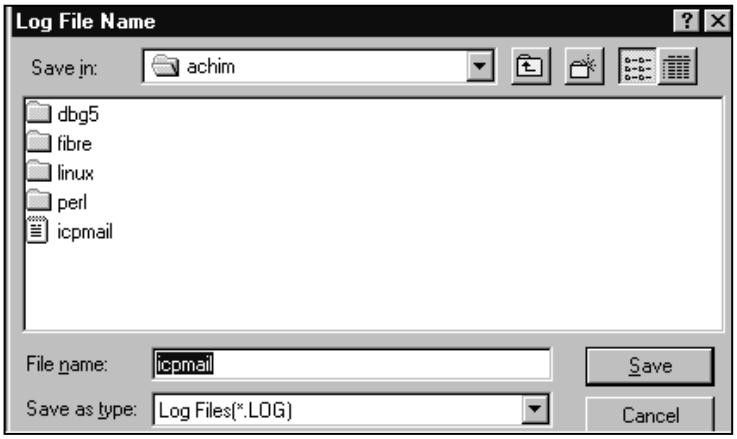
In the IOCTLSrv property sheet you can add / remove users which have remote access to the ICP Controller with the ICP RAID Navigator. Passwords are encrypted.



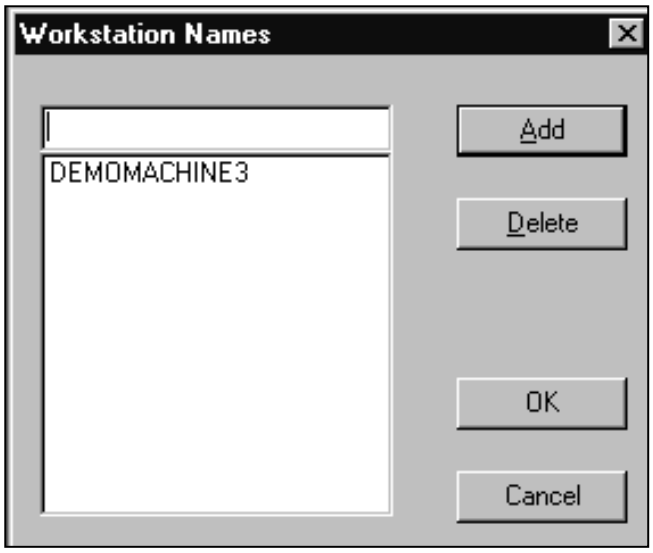
The ICP Mail tool gathers messages from the ICP Service, generates standard mail messages and sends them to pre-defined workstations.
After loading ICPMAIL.EXE and selecting "Settings", you can configure the mailing tool.



If you select "Local System" all messages are displayed on the server itself.
If you select "Log file" you are asked for a log file path/name. All messages are recorded into this file.



"Remote System" allows you to add workstations to which messages are send.

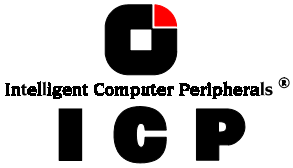


Following is a typical message generated by ICP Mail.

The "Mail" option allows the interfacing to a standard mailing system (like Microsoft Outlook or Exchange).

Chapter L

Appendix



L. Appendix

L.1 Technical Data of the ICP Controller

Board Size	Standard PCI long card format
PCI Bus	32 Bit / 64 Bit 33MHz, 5 Volt
Weight	0,35 kg
Temperature Range in Operation (measured in the enclosure)	10° to 55° C or 50° to 131° F
Temperature Range not in Operation	-10° to 60° C or 14° to 140° F
Humidity in Operation	20% to 75% not condensing
Maximum Altitude in Operation	3000 meter or approximately 10.000 feet
Power Consumption (5V, 12V)	approximately 10 Watt

L.2 Boot Error Messages

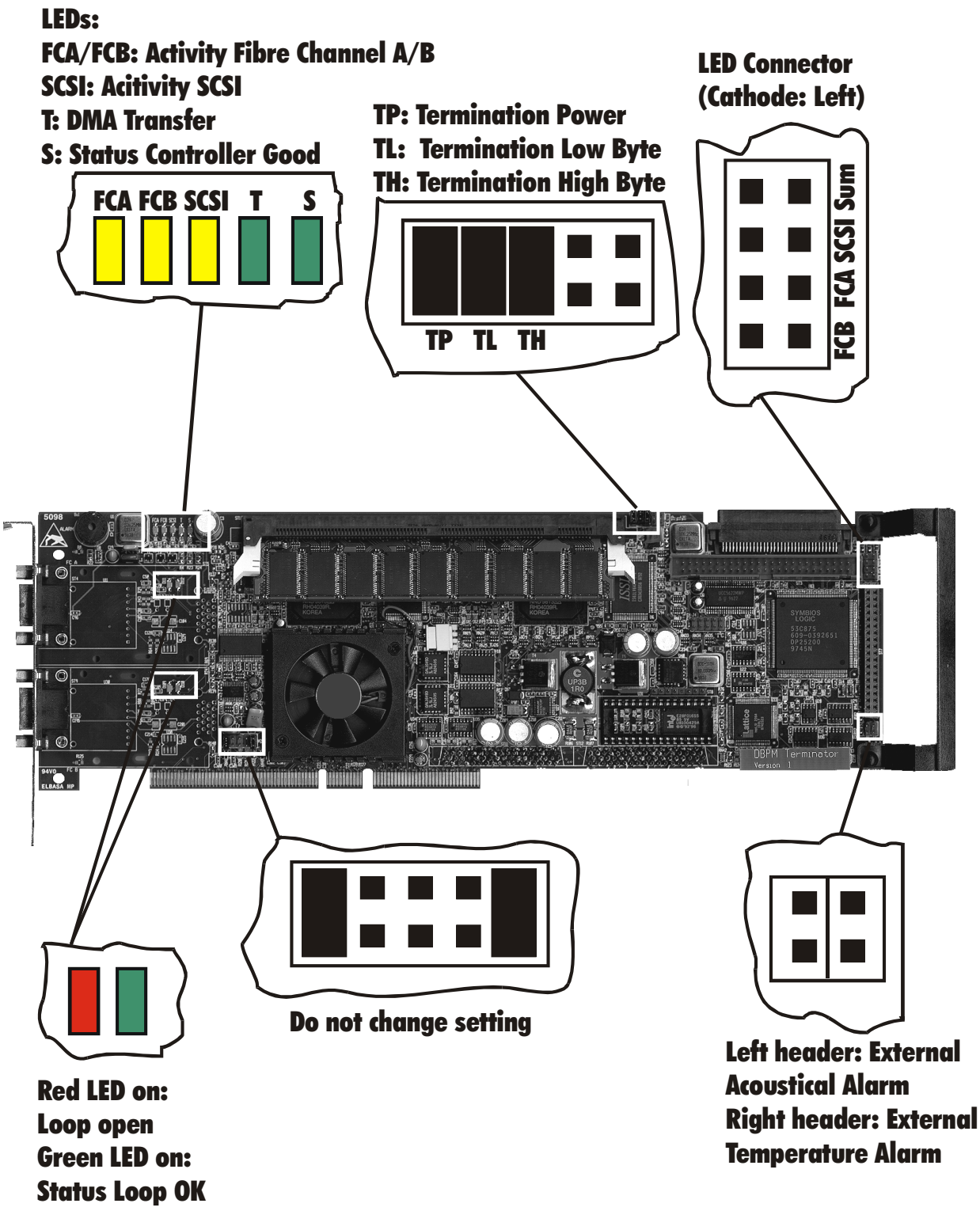
Error Message	**possible cause, remarks**
"Error detected on SIOP x"	SCSI cable defective hard disk connected defective SIOP x defective SCSI bus not properly terminated termination power missing
"Memory error detected":	Memory Module defective

Memory errors of the ICP Controller are also indicated acoustically with the audio alarm of the ICP Controller (3 beeps repeated every 10 seconds).

The following audio alarm sequence indicates that the ICP Controller is tried to be operated without a memory module: "beep-beep-short_pause-beep-beep-long_pause-beep-beep-short_pause-etc.". All ICP Controller require a memory module for operation.

L.3 LEDs and Jumpers

No other Jumpers may be set, changed, removed than TP, TL, TH.
(The picture shows a GDT7x29RN. For a GDT7x19RN headers/LEDs for FCB are not assembled).



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